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by Peter Bunyard

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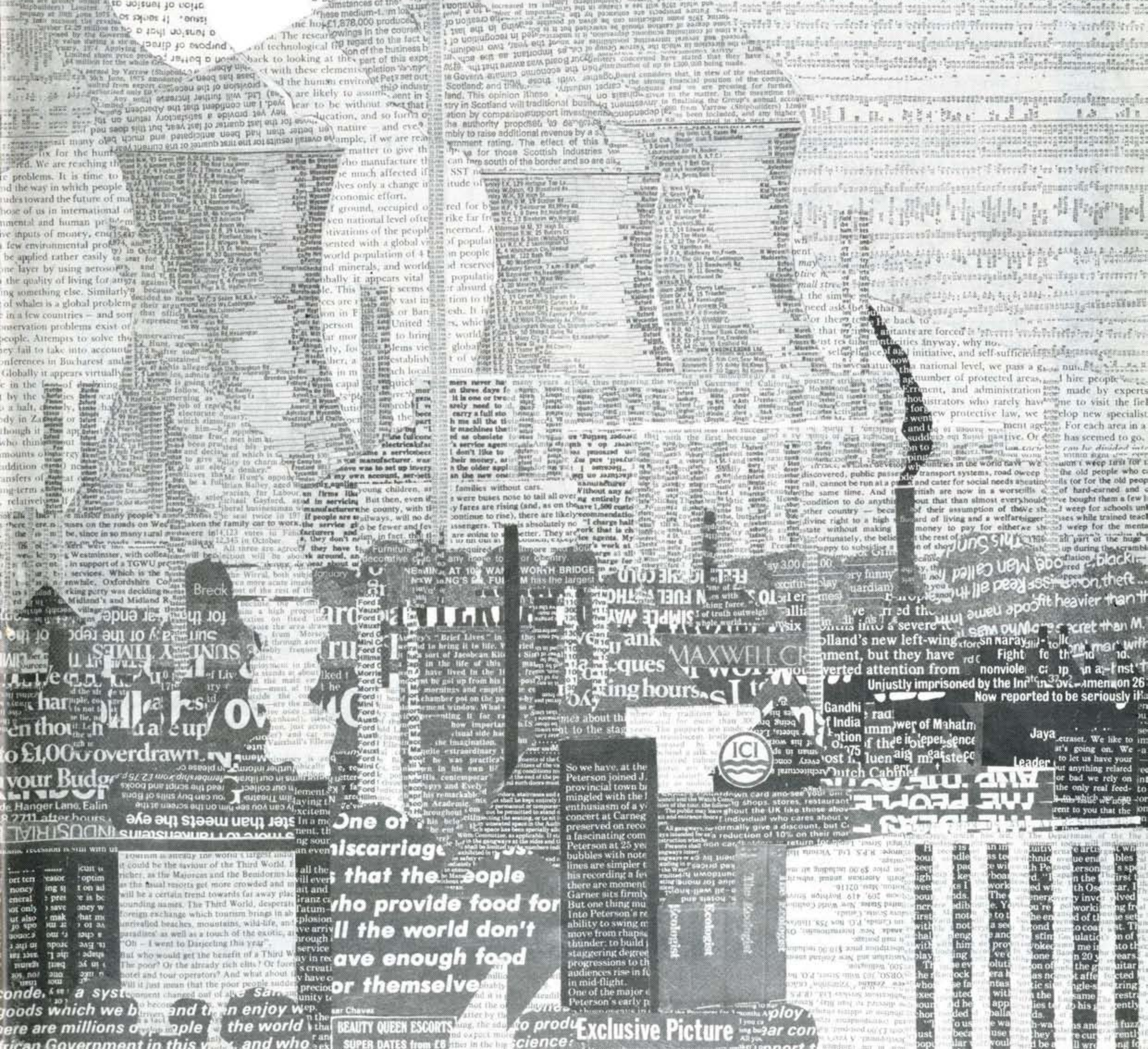

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THE ENERGY ISSUE

Economic growth appears to be a fundamental condition for the continued existence of our industrialised economy, yet before 1970 only a handful of people appreciated that the energy required to achieve that growth might soon be in short supply. Then came the 1973 energy crisis, making all too apparent our dependence on one energy resource in particular – OPEC oil – and prompting frenzied discussion about alternative energy resources. Nevertheless, while introducing some energy conservation measures, both the government and its advisers denied that we in Britain should be anxious over future energy supplies. Soon the North Sea would be yielding its oil, they argued, and with the discoveries of large coal deposits in Yorkshire, together with a commitment to nuclear power, Britain was well on the way to becoming self-sufficient in energy. Likewise in the United States, President Nixon launched his campaign for energy self-sufficiency – Project Independence.

The present oil glut – the result of diminished world consumption owing to economic depression – has fuelled the conviction that abundant energy supplies are there for the taking, and our leaders are now arguing that the sooner we take up the slack the better for our economies. Indeed a booming economy is necessary to provide the investment to bring to fruition our future energy programmes.

There may well be an economic boom within the next few years. Not only will such a boom lull us into a false sense of security, but together with the government's plans to increase our energy consumption will take us, we believe, at a precipitate pace to an energy crisis of hitherto unprecedented dimensions. Indeed whilst energy to achieve that boom may be available we argue in this issue of *The Ecologist* that the energy to sustain it will clearly not be available. The stark conclusion then, is that the days of the industrial society are numbered.

In Mediaeval times the inhabitants of Siena in Tuscany wished to expand their city in order to out-rival their old competitor, Florence, but they could not because they lacked water. Yet so fervent were they in their desire to expand their economy that they began to dream up all manner of extraordinary schemes to procure water. Luckily for us they failed, and Siena has remained an almost unblemished jewel in the Tuscan hills. We in Britain have put ourselves in a comparable position. We think we need more and still more energy, but we and the rest of humanity managed to survive without fossil fuels and nuclear power for a few million years when it was unavailable. Why should we now believe that life would be impossible without that extra energy?

In fact our society is absurdly profligate in its use of energy. There is not one aspect of our daily lives which does not depend on supplementary energy in some form or another. Thus each man, woman and child now needs the energy equivalent of one ton of oil each year, just to provide his daily food requirements, according to Leach in *Energy and Food Production,* and as the ecologist, Howard Odum remarks in his book *Environment, Power and Society* potatoes are no longer made of the sun and soil but of petroleum. And what is more symbolic of that profligacy than Concorde, which in taking a few rich business men and experience-seekers at high speed across the Atlantic burns up its weight equivalent in kerosene? In addition, Concorde makes a great deal of noise when taking off and landing, thus reversing the trend towards quieter aircraft.

The government considers North Sea oil the lynch-pin of any future industrial development, and oil is now coming ashore from BP's Fortes field. Yet North Sea oil is hardly likely to produce the hoped-for boon. Much of the enormous capital cost has been incurred outside Britain, which could not even produce the steel for the pipelines and oil rigs, so adding to our balance of payments problems. According to Ian Fells, we will be forced to exploit North Sea oil as rapidly as possible both because the oil companies must get a reasonable return on their investment, and because not just Britain but the rest of the EEC countries will also need the oil. In all probability North Sea oil production will peak within 10 to 15 years from now after which Britain – probably with an even greater consumption of oil than at present – will be forced again to buy its oil from OPEC.

At today's prices many nations, including Britain, are finding it difficult to maintain viable economies. We are fortunate at the moment because the oil rich Arab states and Iran are spending a significant proportion of their oil revenues back in Britain. But Third World countries without indigenous oil, and some industrialised nations, from which the richer OPEC members are not purchasing goods in any great quantities, are finding themselves in great economic and financial difficulty. It seems likely that soon we shall start seeing oil-importing countries defaulting on their payment to OPEC, which is then hardly likely to continue selling them oil.

Increased oil prices have had many side effects. India for example has had to reduce its fertiliser consumption and the green revolution which had begun to do well in the early 70's is beginning to run out of steam. In addition, as Eckland points out in his article on firewood, the rising cost of oil has deprived millions in Third World countries of a cheap fuel for cooking and heating. Unprecedented population pressure on indigenous resources is having horrific environmental effects. In the highlands of many different countries villagers are having to go further and further for firewood and hillsides are rapidly becoming denuded of trees with consequent erosion and landslides, together with the silting up of rivers and flooding, sometimes many hundreds of miles downstream. In parts of India trees are actually debarked by people desperate for fuel, and more and more people are turning to dung-burning. Indeed the practice has now begun in Nepal for the first time in its history.

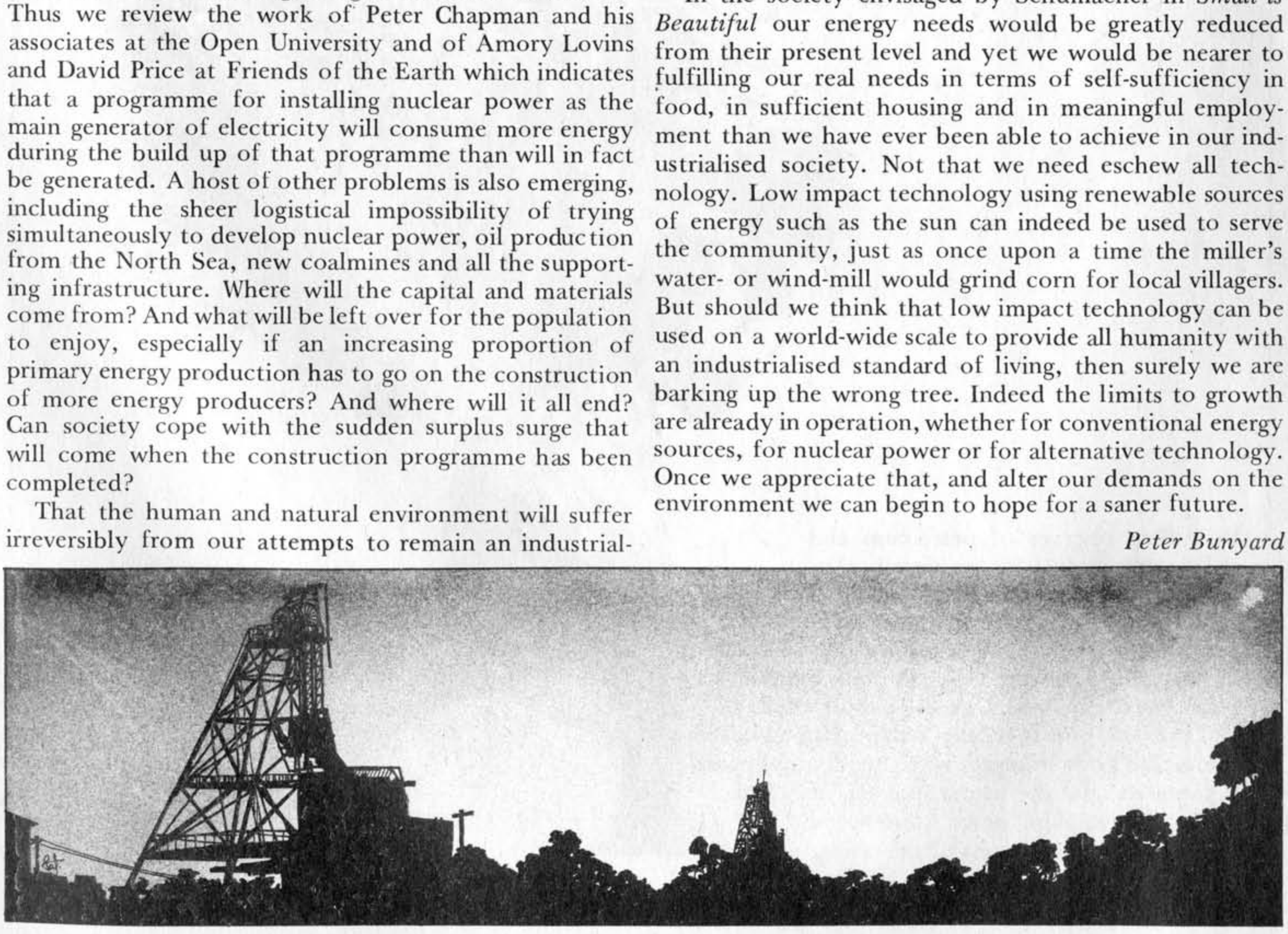
In the industrialised nations nuclear power advocates are hopeful that by the year 2000 a large proportion of electricity generation will be supplied by thermal burners together with some breeder reactors. Indeed Bethe, in this January's *Scientific American,* claims that nuclear fission is absolutely vital to the future of industrialised nations since no alternatives can provide the necessary energy inputs for much longer. To achieve such a target nuclear power will have to be expanded enormously and some forecasters talk of a doubling of nuclear power every three or four years. The likelihood that nuclear power can be expanded at that rate, if at all, seems increasingly far-fetched. Not only is there growing environmental resistance to the proliferation of nuclear power, with action groups springing up in all the major industrial countries, but actual constraints within the economic system are beginning to manifest themselves. Thus we review the work of Peter Chapman and his associates at the Open University and of Amory Lovins and David Price at Friends of the Earth which indicates that a programme for installing nuclear power as the main generator of electricity will consume more energy during the build up of that programme than will in fact be generated. A host of other problems is also emerging, including the sheer logistical impossibility of trying simultaneously to develop nuclear power, oil production from the North Sea, new coalmines and all the supporting infrastructure. Where will the capital and materials come from? And what will be left over for the population to enjoy, especially if an increasing proportion of primary energy production has to go on the construction of more energy producers? And where will it all end? Can society cope with the sudden surplus surge that will come when the construction programme has been completed?

That the human and natural environment will suffer irreversibly from our attempts to remain an industrialised nation goes without saying. In Britain the present annual loss of good agricultural land to urban development is in the region of 80,000 acres per year. Imagine what it would be with the construction of 80 more 1000-megawatt nuclear reactors. And what happens to those reactors when they come to the end of their useful life after 25 years or so? Will they remain to scar the horizon, abandoned untouchable hulks, while new replacements go up all around, to become derelict themselves a generation later?

Now, some 150 years after the beginning of the industrial revolution we have become so hooked on energy that we are no longer capable of asking ourselves what in reality it is doing to us and our environment. Energy used on its present scale inevitably damages the environment, but it also brings about social disintegration. Thus production has become a goal in itself in our society, divorced both from people's needs and from their participation. We now have massive unemployment simultaneous with high industrial productivity and a growing gross national product. What we need desperately is a society in which the production process is in the hands of the community and the machine is the servant of man, not the other way round. That stricture applies equally to the country and to the town, and for a healthy society we need people back on the land. For full productivity combined with full employment it is essential that we divide and sub-divide land into smaller units. Instead of being the exception the family smallholding should be the norm.

In the society envisaged by Schumacher in *Small is Beautiful* our energy needs would be greatly reduced from their present level and yet we would be nearer to fulfilling our real needs in terms of self-sufficiency in food, in sufficient housing and in meaningful employment than we have ever been able to achieve in our industrialised society. Not that we need eschew all technology. Low impact technology using renewable sources of energy such as the sun can indeed be used to serve the community, just as once upon a time the miller's water- or wind-mill would grind corn for local villagers. But should we think that low impact technology can be used on a world-wide scale to provide all humanity with an industrialised standard of living, then surely we are barking up the wrong tree. Indeed the limits to growth are already in operation, whether for conventional energy sources, for nuclear power or for alternative technology. Once we appreciate that, and alter our demands on the environment we can begin to hope for a saner future.

Peter Bunyard



The Other Energy Crisis: Firewood

by Erik P. Eckholm

Dwindling reserves of petroleum and artful tampering with its distribution are the stuff of which headlines are made. Yet for more than a third of the world's people, the real energy crisis is a daily scramble to find the wood they need to cook dinner. Their search for wood, once a simple chore and now, as forests recede, a day's labour in some places, has been strangely neglected by diplomats, economists, and the media. But the firewood crisis will be making news – one way or another – for the rest of the century.

Photo: Barnaby's Picture Library.

While chemists devise ever more sophisticated uses for wood, including cellophane and rayon, at least half of all the timber cut in the world still fulfils its original role for humans – as fuel for cooking and, in some colder mountain regions, a source of warmth. Nine-tenths of the people in most poor countries today depend on firewood as their chief source of fuel. And all too often, the growth in human population is outpacing the growth of new trees – not surprising when the average user burns as much as a ton of firewood a year.[1] The results are soaring wood prices, a growing drain on incomes and physical energies in order to satisfy basic fuel needs, a costly diversion of animal manures for cooking food rather than producing it, and an ecologically disastrous spread of treeless landscapes.

The firewood crisis is probably most acute today in the countries of the densely populated Indian subcontinent, and in the semi-arid stretches of Central Africa fringing the Sahara Desert, though it plagues many other regions as well. In Latin America, for example, the scarcity of wood and charcoal is a problem throughout most of the Andean region, Central America, and the Caribbean.

An Economic Burden

The costs of firewood and charcoal are climbing throughout most of Asia, Africa, and Latin America. Those who can, pay the price, and thus must forego consumption of other essential goods. Wood is simply accepted as one of the major expenses of living. In Niamey, Niger, deep in the drought-plagued Sahel in West Africa, the average manual labourer's family now spends nearly one-fourth of its income on firewood. In Ouagadougou, Upper Volta, the portion is 20-30 per cent.[2] Those who can't pay so much may send their children, or hike themselves, out into the surrounding countryside to forage – if enough trees are within a reasonable walking distance. Otherwise, they may scrounge about the town for twigs, garbage, or anything burnable.

It is not in the cities but in the rural villages that most people in the affected countries live, and where most firewood is burned. The rural, landless poor in parts of India and Pakistan are now facing a new squeeze on their meagre incomes. Until now they have generally been able to gather wood for free among the trees scattered through farmlands, but as wood prices in the towns rise, landlords naturally see an advantage in carting available timber into the nearest town to sell rather than giving it to the nearby labourers. While this commercialisation of firewood raises the hope that entrepreneurs will see an advantage in planting trees to develop a sustainable, labour-intensive business, so far a depletion of woodlands has been the more common result. *And the rural poor, with little or no cash to spare, are in deep trouble in either case.*

With the farmland trees and the scrubby woodlands of unfarmed areas being depleted by these pressures, both the needy and the entrepreneurs are forced to poach for fuel wood in the legally protected, economically and ecologically essential national forest reserves. The gravity of the poaching problem in India has been reflected in the formation of special mobile guard-squads and mobile courts to try captured offenders, but law enforcement measures have little effect in such an untenable situation. Acute firewood scarcity has undermined administrative control even in China, where trees on commune plantations are sometimes surreptitiously uprooted for fuel almost as soon as they are planted.[3]

Trees are becoming scarce in the most unlikely places. In some of the most remote villages in the world, deep in the once heavily forested Himalayan foothills of Nepal, journeying out to gather firewood and fodder is now an *entire day's* task. Just one generation ago the same expedition required no more than an hour or two.[4]

Ecological Consequences

Because those directly suffering its consequences are mostly illiterate, and wood shortages lack the photogenic visibility of famine, the firewood crisis has not provoked much world attention. And in a way there is little point in calling this a world problem, for fuel-wood scarcity, unlike oil scarcity, is always localised in its apparent dimensions. Economics seldom permit fuel wood to be carried or trucked more than a few hundred miles from where it grows, let alone the many thousands of miles traversed by the modern barrel of oil. To say that firewood is scarce in Mali or Nepal is of no immediate consequence to the Boy Scout building a campfire in Pennsylvania, whereas his parents have already learned that decisions in Saudi Arabia can keep the family car in the garage.

Unfortunately, however, the consequences of firewood scarcity are seldom limited to the economic burden placed on the poor of a particular locality. The accelerating degradation of woodlands throughout Africa, Asia, and Latin America, caused in part by fuel gathering, lies at the heart of what will likely be the most profound ecological challenge of the late twentieth century. On a global basis, an ecological threat to human well-being far more insidious and intractable than the industrial pollution of our air and water – which has pre-empted thinking on environmental quality – is the undermining of the productivity of the land itself through soil erosion, increasingly severe flooding, creeping deserts, and declining soil fertility. All these problems are accentuated by deforestation, which is spreading as lands are cleared for agriculture and as rising populations continue their search for firewood. Rainwater falling on tree-covered land tends to soak into the ground rather than rush off; erosion and flooding are thus reduced, and more water seeps into valuable underground pools and spring sources.

The Dust Bowl years in the Great Plains of the thirties taught Americans the perils of devegetating a region prone to droughts. The images provided by John Steinbeck in *The Grapes of Wrath* of the human dislocation wrought by that interaction of man, land, and climate could easily describe present-day events in large semi-arid stretches of Africa along the northern and southern edges of the Sahara, and around the huge Rajasthan Desert in Northwest India. Overgrazing by oversized herds of cattle, goats, and sheep is the chief culprit, but fuel-wood gathering is also an important contributor to the destruction of trees in these regions. Firewood is a scarce and expensive item throughout the sub-Saharan fringe of Africa, all the way from Senegal to Ethiopia, but citizens in towns like Niamey are paying a much higher price than they realise for their cooking fuel. The caravans that bring in this precious resource are contributing to the creation of desert-like conditions in a wide band below the desert's edge. Virtually all trees within 70 kilometres of Ouagadougou have been consumed as fuel by the city's inhabitants, and the circle of land 'strip-mined' for firewood – without reclamation – is continually expanding.

Similar pressures of overgrazing and deforestation in North Africa are having the same consequences. H. N. Le Houérou of the United Nations Food and Agriculture Organisation figures that 100,000 hectares of land are lost to the desert *each year* due to human activities in Algeria, Morocco, Libya, and Tunisia.[5] In an interesting experiment, the Libyans and others have tried spraying oil on the sand dunes to hold them back, but most arid countries will have to follow Algeria's recent lead in undertaking a massive tree-planting campaign if they hope to stop the sand. India, too, is forfeiting farmlands and rangelands to desert sands, while vaster dry regions, which stretch eastward from the Rajasthan Desert and constitute perhaps a fifth of the country, now present a nearly treeless landscape. Wind erosion is chronic and the agricultural yields extracted from the infertile subsoil are either falling or have finally stabilised at a low level.

Dangerous Substitutes

In the Indian subcontinent, the most pernicious result of firewood scarcity is probably not the destruction of tree cover itself, but the alternative to which a good share of the people in India, Pakistan, and Bangladesh have been forced. A visitor to almost any village in the subcontinent is greeted by omnipresent pyramids of hand-moulded dung patties drying in the sun. In many areas these dung cakes have been the only source of fuel for generations, but now, by necessity their use is spreading further. Between 300 and 400 million tons of wet dung – which shrinks to 60 to 80 million tons when dried – is annually burned for fuel in India alone, robbing farmland of badly needed nutrients and organic matter. The plant nutrients wasted annually in this fashion in India equal more than a third of the country's chemical fertilizer use. Looking only at this direct economic cost, it is easy to see why the country's National Commission on Agriculture recently declared that "the use of cow dung as a source of non-commercial fuel is virtually a crime." Dung is also burned for fuel in parts of the Sahelian zone in Africa, Ethiopia, Iraq, and in the nearly treeless Andean valleys and slopes of Bolivia and Peru, where the dung of llamas has been the chief fuel in some areas since the days of the Incas.[6]

Even more important than the loss of agricultural nutrients is the damage done to soil structure and quality through the failure to return manures to the fields. Organic materials – humus and soil organisms which live in it – play an essential role in preserving the soil structure and fertility needed for productive farming. Organic matter holds the soil in place when rain falls and wind blows, and reduces the wasteful, polluting runoff of chemical nutrients where they are applied, thus increasing the efficiency of their use. These considerations apply especially to the soils in tropical regions where most dung is now burned, because tropical topsoils are usually thin and, once exposed to the harsh treatment of the burning sun and torrential monsoon rains, are exceptionally prone to erosion, and to losing their structure and fertility.

Peasants in the uplands of South Korea have found another, equally destructive way to cope with the timber shortage. A United Nations forestry team visiting the country in the late 1960s found not only live tree-branches, shrubs, seedlings, and grasses being cut for fuel; many hillsides were raked clean of all leaves, litter, and burnable materials. Raking in this fashion, to meet needs for home fuel and farm compost, robs the soil of both a protective cover and organic matter, and the practice was cited by the U.N. experts as "one of the principal causes of soil erosion in Korea." Firewood scarcity similarly impairs productivity in Eastern Nigeria, where the Tiv people have been forced to uproot crop residues after the harvest for use as fuel. Traditionally, the dead stalks and leaves have been left to enrich the soil and hold down erosion.[7]

A Closing Circle

The increasing time required to gather firewood in many mountain villages of Nepal is leading to what the kingdom's agricultural officials fear most of all. For, once procuring wood takes too long to be worth the trouble, some farmers start to use cow dung, which was formerly applied with great care to the fields, as cooking fuel. As this departure from tradition spreads, the fertility of the hills, already declining due to soil erosion, will fall sharply. In the more inaccessible spots there is no economic possibility whatsoever of replacing the manure with chemical fertilizers.

And so the circle starts to close in Nepal, a circle long completed in parts of India. As wood scarcity forces farmers to burn more dung for fuel, and to apply less to their fields, falling food output will necessitate the clearing of ever larger, ever steeper tracts of forest – intensifying the erosion and landslide hazards. Even Nepal's key economic planning body, the National Planning Commission, now says that if present trends continue, a "semi-desert type of ecology in the hilly regions" will be created.

Though most dramatically apparent in Nepal, this same cluster of phenomena threatens the future inhabitability of the entire stretch of Himalayan foothills, from Afghanistan through Northern Pakistan, India and Nepal to Burma. And the negative consequences by no means stop at the base of the hills. When soil washes away it must relocate somewhere, and the rising load of silt carried by Asia's rivers is choking up expensive reservoirs and irrigation works. Most threatening of all to food-production prospects on the Indian subcontinent, where nearly one in every five human beings lives, is a rise in the frequency and severity of flooding in Pakistan, India, and possibly Bangladesh, the result of denuded watersheds off which rainfall rushes quickly, and of the excessive load of sediment from upstream that builds up river beds, reducing their capacity to channel water.

Firewood scarcity, then, is intimately linked to the food problem facing many countries in two ways. Deforestation and the diversion of manures as fuel are sabotaging the land's ability to produce food. Meanwhile, as an Indian official put it, "Even if we somehow grow enough food for our people in the year 2000, how in the world will they cook it?"

A Renewable Resource

The firewood crisis is in some ways more, and in others less, intractable than the energy crisis of the industrialised world. Resource scarcity can usually be attacked from either end, through the conservation of demand or the expansion of supply. The world contraction in demand for oil in 1974 and early 1975, for example, helped to ease temporarily the conditions of shortage.

But the firewood needs of the developing countries cannot be massively reduced in this fashion. The energy system of the truly poor contains no easily trimmable fat such as four to five-thousand-pound private automobiles represent. Furthermore, a global recession does little to dampen the demand for firewood as it temporarily has in the case of oil. The unfortunate truth is that the amount of wood burned in a particular country is almost completely determined by the number of people who need to use it. In the absence of suitable alternative energy sources, future firewood needs in these countries will be determined largely by population growth.

The simple arithmetic of exponential growth suggests the immensity of the fuel-wood challenge facing many poor countries. Thus, 99 per cent of Tanzania's population burns an average of 1.8 tons of wood per person per year. Since Tanzania's population is now just over 15 million, about 27 million tons of wood will be burned for fuel in 1975. But if Tanzania's population should continue growing at the present rate of 2.7 per cent annually, it will multiply *14-fold in a century.* If the proportion of wood users should remain constant, the consumption of wood for fuel would also multiply 14-fold to reach 370 million tons per year. Even if the demographers are surprised by quick progress in slowing population growth over the next few decades, the demand for basic resources like firewood will still push many countries to their limits.

Fortunately trees, unlike oil, are a renewable resource when properly managed. The logical immediate response to the firewood shortage, one that will have many incidental ecological benefits, is to plant more trees in plantations, on farms, along roads, in shelter belts, and on unused land throughout the rural areas of the poor countries. For many regions, fast-growing tree varieties are available that can be culled for firewood inside of a decade.

The concept is simple, but its implementation is not. Governments in nearly all the wood-short countries have had tree-planting programmes for some time – for several decades in some cases. National forestry departments in particular

Photo: Barnaby's Picture Library.

Women Carrying fire wood.

have often been aware of the need to boost the supply of wood products and the need to preserve forests for a habitable environment. But several problems have plagued these programmes from the beginning.

One is the sheer magnitude of the need for wood, and the scale of the growth in demand. Population growth, which surprised many with its acceleration in the post-war era, has swallowed the moderate tree-planting efforts of many countries, rendering their impact almost negligible. Wood-producing programmes will have to be undertaken on a far greater scale than most governments presently conceive if a real dent is to be made in the problem.

The problem of scale is closely linked to a second major obstacle to meeting this crisis: the perennial question of political priorities and decision-making time-frames. What with elections to win, wars to fight, dams to build, and hungry mouths to feed, it is hard for any politician to concentrate funds and attention on a problem so diffuse and seemingly long-term in nature. Some ecologists in the poor countries have been warning their governments for decades about the dangers of deforestation and fuel shortages, but tree-planting programmes don't win elections.

Despite these inherent political problems, India's foresters made a major breakthrough a few years back as the government drew up its five-year development plan for the mid to late seventies. Plans were laid for the large-scale establishment of fast-growing tree plantations, and for planting trees on farms and village properties throughout the country.[8] A programme is going ahead now, but there have been some unexpected events since the projects were first contemplated two or three years ago: the quintupling of the world price of petroleum, the tripling in price and world shortages of grains and fertilizers, a wholesale diversion of development funds just to muddle through 1974 without a major famine and a total economic breakdown. India's development efforts were set back several years by recent events, and forestry programmes have not been immune to this trend.

Political, Cultural, and Administrative Tangles

Even when the political will is there and the funds are allocated, implementing a large-scale reforestation campaign is an unexpectedly complex and difficult process. Planting millions of trees and successfully nurturing them to maturity is not a technical, clearly boundaried task like building a dam or a chemical fertilizer plant. Tree-planting projects almost always become deeply enmeshed in the political, cultural, and administrative tangles of a rural locality; they touch upon, and are influenced by, the daily living habits of many people, and they frequently end in failure.

Most of the regions with too few trees also have too many cattle, sheep, and goats. Where rangelands are badly overgrazed, the leaves of a young sapling present an appetising temptation to a foraging animal. Even if he keeps careful control of his own livestock, a herdsman may reason that if his animals don't eat the leaves, someone else's will. Marauding livestock are prime destroyers of tree-planting projects throughout the less developed world. Even if a village is internally disciplined enough to defend new trees from its own residents, passing nomads or other wanderers may do them in. To be successful, then, reforestation efforts often require a formidable administrative effort to protect the plants for years – not to mention the monitoring of timber harvesting and replanting activities once the trees reach maturity.

Village politics can undermine a programme as well. An incident from Ethiopia a few years back presents an extreme case, but its lessons are plain. A rural reforestation programme was initiated as a public works scheme to help control erosion and supply local wood needs. The planting jobs were given to the local poor, mostly landless labourers who badly needed the low wages they could earn in the planting programme. Seedlings were distributed, planting commenced, and all seemed to be going well until the overseers journeyed out to check the progress. They found that in many areas the seedlings had been planted upside-down! The labourers, of course, well knew the difference between roots and branches; they also knew that given the feudal land-tenure system in which they were living, most of the benefits of the planting would flow one way or another into the hands of their lords. They were not anxious to work efficiently for substandard wages on a project that brought them few personal returns.[9]

In country after country, the same lesson has been learned: tree-planting programmes are most successful when a majority of the local community is deeply involved in planning and implementation, and clearly perceives its self-interest in success. Central or state governments can provide stimulus, technical advice, and financial assistance, but unless community members clearly understand why lands to which they have traditionally had free access for grazing and wood-gathering are being demarcated into a plantation, they are apt to view the project with suspicion or even hostility. With wider community participation, on the other hand, the control of grazing patterns can be built into the programme from the beginning, and a motivated community will protect its own project and provide labour at little or no cost.

An approach like this – working through village councils, with locally mobilised labour doing the planting and protection work – is now being tried in India. This approach too has its pitfalls; Indian villages are notoriously faction-ridden, and the ideal of the whole community working together for its own long-term benefit may be somewhat utopian. But if it can get underway on a large scale, the national programme in India may succeed. Once given a chance, fast-growing trees bring visible benefits quickly, and they just could catch on. The Chinese have long used the decentralised, community, labour-mobilising approach to reforestation, apparently with moderate success.

Alternative Fuels

Whatever the success of tree-planting projects, the wider substitution of other energy sources where wood is now being used would, if feasible, contribute greatly to a solution of the firewood problem. A shift from wood-burning stoves to those running on natural gas, coal, or electricity has indeed been the dominant global trend in the last century and a half. As recently as 1850, wood met 91 per cent of the fuel needs of the United States, but today in the economically advanced countries, scarcely any but the intentionally rustic, and scattered poor in the mountains, chop wood by necessity anymore. In the poor countries, too, the proportion of wood users is falling gradually, especially in the cities, which are usually partly electrified, and where even residents with little income may cook their food with bottled gas or kerosene. Someone extrapolating trends of the first seven decades of this century might well have expected the continued spread of kerosene and natural gas use at a fairly brisk pace in the cities and into rural areas, eventually rendering firewood nearly obsolete.

Events of the last two years, of course, have abruptly altered energy-use trends and prospects everywhere. The most widely overlooked impact of the fivefold increase in oil prices, an impact drowned out by the economic distress caused for oil-importing countries, is the fact that what had been the most feasible substitute for firewood, kerosene, has now been pulled even farther out of reach of the world's poor than it already was. The hopes of foresters and ecologists for a rapid reduction of pressures on receding woodlands through a stepped-up shift to kerosene withered overnight in December, 1973, when OPEC announced its new oil prices. In fact, the dwindling of world petroleum reserves and the depletion of woodlands reinforce each other; climbing firewood prices encourage more people to use petroleum-based products for fuel, while soaring oil prices make this shift less feasible, adding to the pressure on forests.

Fossil fuels are not the only alternative energy source being contemplated, and over the long term many of those using firewood, like everyone else, will have to turn in other directions. Nothing, for example, would be better than a dirt-cheap device for cooking dinner in the evening with solar energy collected earlier in the day. But actually developing such a stove and introducing it to hundreds of millions of the world's most tradition-bound and penniless families is another story. While some solar cookers are already available, the cost of a family unit, at about $35-50, is prohibitive for many since, in the absence of suitable credit arrangements, the entire price must be available at once. Furthermore, no inexpensive means of storing heat for cloudy days and for evenings has yet been devised.[10]

Indian scientists have pioneered for decades with an ideal-sounding device that breaks down manures and other organic wastes into methane gas for cooking and a rich compost for the farm. Over eight thousand of these bio-gas plants, as they are called, are now being used in India. Without a substantial reduction in cost, however, they will only slowly infiltrate the hundreds of thousands of rural villages where the fuel problem is growing. Additionally as the plants are adopted, those too poor to own cattle could be left worse off then ever, denied traditional access to dung but unable to afford bio-gas.[11] Still, it is scientific progress with relatively simple, small-scale devices like solar cookers and bio-gas plants that will likely provide the fuel source of the future in most poor countries.

In terms of energy, Nepal is luckier than many countries in one respect. The steep slopes and surging rivers that cause so many environmental problems also make Nepal one of the few remaining countries with a large untapped hydro-electric potential. The latent power is huge, equalling the hydro-electric capacity of Canada, the United States, and Mexico combined. Exploitation of this resource will be expensive and slow, but would relieve some of the pressures being placed on forests by the larger towns of Nepal and Northern India. On the other hand, cheap electricity will only partly reduce firewood demands, since the electrification of isolated villages in the rugged Himalayas may never be economically feasible.

The Ultimate Ecologist

The Ultimate Ecologist is concerned about the amount of energy burnt in the shining of the sun, while effectively lighting only one-half the surface of Earth at a time. He protests by writing 3 angry letters, noting in each that the 616 million tons of hydrogen used to obtain 612 million tons of helium each second is, to say the least, "a bit excessive". He sends them to his senator, congressman, and the creator of the universe in care of the local postmaster. One day a few weeks later, he receives 2 congenial letters from Washington thanking him for his interest. That same night, a bolt of lightning strikes his home.

Peter Payack

Back to the Basics

Firewood scarcity and its attendant ecological hazards have brought the attitude of people toward trees into sharp focus. In his essay "Buddhist Economics", E. F. Schumacher praises the practical as well as esoteric wisdom in the Buddha's teaching that his followers should plant and nurse a tree every few years.[12] Unfortunately, this ethical heritage has been largely lost, even in the predominantly Buddhist societies of Southeast Asia. In fact, most societies today lack an ethic of environmental co-operation, an ethic not of conservation for its own sake, but of human survival amid ecological systems heading towards collapse.

This will have to change, and fast. The inexorable growth in the demand for firewood calls for tree-planting efforts on a scale more massive than most bureaucrats have ever even contemplated, much less planned for. The suicidal deforestation of Africa, Asia, and Latin America must somehow be slowed and reversed. Deteriorating ecological systems have a logic of their own; the damage often builds quietly and unseen for many years, until one day the system collapses with lethal vengeance. Ask anyone who lived in Oklahoma in 1934, or in Chad in 1975.

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(W.W. Norlon. N.Y.)

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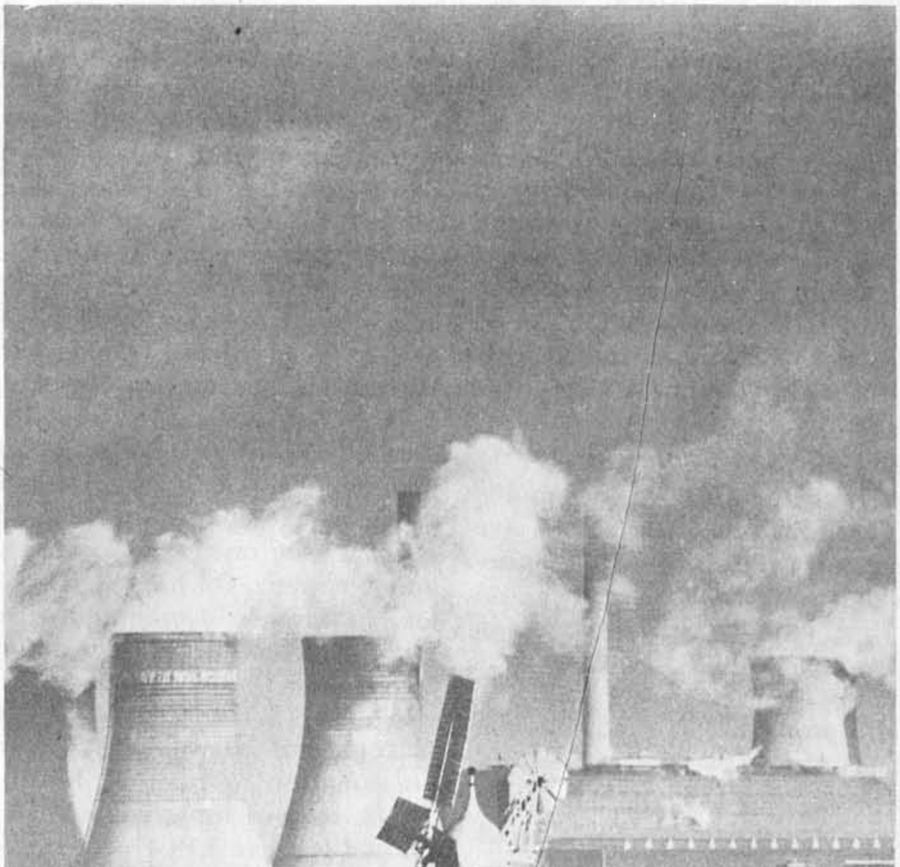
The Future of Energy in Our Society

by Peter Bunyard

From the very beginning of the Industrial Revolution, the Cobbetts and the Morrises of this world glimpsed the nightmarish reality of a society that was going production-mad. But it was not until the late 1960s, commensurate with the incredible forward surge of consumerism, that a good many of us – and not just outstanding visionaries – began to ask ever more stridently where we might be heading. Too often we critics lacked the factual or even the intellectual tools demanded of us in this scientific age in presenting our case against the industrial society. Instead, and undoubtedly with some success, we had to resort to emotional statements that expressed our intuitive distaste for an economic enterprise which we felt degraded both man and the environment.

Until recently, the industrial establishment did its best to write us off as being politically and economically naive and as little more than a selfish middle-class minority that wished to hog the good things of the environment for itself. Whether they intended to or not, OPEC and particularly the more militant Arabs have changed all that. After the Yom Kippur war of October 1973, oil-consuming nations learnt the bitter truth that they could be cut to the quick, not only be oil embargoes and limited supplies of oil, but also by the simple fact of their oil costing a lot more. OPEC had rocked the boat and had effectively demonstrated that the gigantic industrial enterprise of the West, or of the Soviet bloc for that matter, had very shaky foundations indeed.

But it isn't only OPEC with its expensive oil that has become a problem for the West. Almost overnight, and with increasing confidence, groups of dissident scientists have grown up in that despised muddle-headed counter-culture and have challenged the viability of the industrial establishment. Not one issue have these scientists left unchallenged and no longer can the establishment say with confidence that society will discover, and be able to exploit, alternative sources of energy.



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Nothing of course is clear-cut, but it is a risk, with the odds stacking against it, for any government to pursue industrial growth on the assumption that the energy supplies for this growth will be available.

Nations have never yet had to face real fuel shortages. Admittedly there have been moments of crisis, during wars, oil embargoes, strikes by energy workers, and breakdowns in the system as in the United States' famous 'Brown-outs'. But such crises pass and governments soon get back to their old game of exhorting industry to expand its production as if there were no foreseeable limits to fuel. In theory, energy is boundless. If we add up fossil fuel reserves, fissionable material, geothermal energy, wind- and hydro-power, the vast sink of energy in thermonuclear fusion, let alone the sun's gigantic daily input, we finish up with astronomical quantities of energy. Yet in the end, all the energy in the world will avail us nothing unless we can obtain it at a reasonable price, both in monetary and energy terms. Thus if nearly as much energy has to be put into the extraction of oil from shale as can be got out, it is obvious that shale would not be a reasonable source of energy; as it is, the economic cutoff point would anyway have come long before.

But the problem is not even as simple as that. An energy source may well be available that will give reasonable financial and thermodynamic returns, and yet the world may still find itself unable to afford the growth for which it is planning. It is a "rate and magnitude problem", as Amory Lovins points out in *Non-Nuclear Futures.*[1]

"On a global scale, for example," says Lovins, "if energy use increases 5 per cent a year and if we commission one large reactor (1000 electrical megawatts) per day, starting now, then in 2000 we shall have spent approximately 10 current US GNP-years on reactors – *and we must still get most of our primary energy from fossil fuels and must burn them twice as fast as now.*" (His italics.)

The problem is one of dynamics. Each time the world advances further along the path of industrial expansion it must lay its hands on a fuel source that is ever more readily accessible (obviously with the aid of technology) than previous fuel sources. Historically, mankind has always managed to discover new sources of energy in time to take him easily on to the next phase in his industrial development. Hence there have been no real fuel shortages. Thus coal proved an economically viable source of energy to take over from wood, wind and water in the nineteenth century and gave the main spur to the Industrial Revolution.

Petroleum, the Fuel *Par Excellence*

The impact of coal was undoubtedly dramatic, and we have only to think back to Britain's black Midland towns with their stacks of belching chimneys to get the picture. But in reality, coal's contribution to the industrial society has begun to pale before that of petroleum oil, which has wholly transformed every individual's way of life. Indeed, oil and the consumer society are practically one. Thus supermarkets with their frozen, packaged goods, the stream of traffic on motorways, the cheap holiday abroad, and the plastic ingredients of our society, let alone the multifarious use of petroleum products on the land, are a consequence of cheap, bountiful supplies of oil, obtained with such ease from the enormous reserves of the Middle East, as they once were from Texas and Louisiana. Oil has indeed made an amazing take-over since the Second World War. In 1946 Britain consumed 186.3 million tons of coal and only 13.7 million coal-equivalent tons of oil. In 1973 Britain's consumption of coal had fallen to 131.3 million tons, while that of oil had leapt to 159.4 million coal-equivalent tons – a 12-fold increase in 25 years.

Even before the October 1973 Yom Kippur war, it was clear that the extraordinary rise in oil consumption could not continue for long. Petroleum experts such as Warman of BP and Hubbert of the United States were pretty well in agreement that ultimate recoverable reserves of oil lay in the region of 2000 billion barrels at best and around 1300 billion barrels at worst. Thus, with present trends in consumption, gigantic fields the size of Prudhoe Bay or the North Sea would have to be discovered several times a year to meet future demands – a most improbable event – and hence they estimated that within thirty years world oil production would go into decline, by which time countries would have had to find a substitute fuel.

The world's coal reserves are undoubtedly much greater than its petroleum reserves. The United States, for example, has sufficient coal to supply its fossil fuel needs for several hundred years at the present rate of consumption, while its oil will hardly take it into the next century. Britain too is well endowed with coal. But the problem is not just to maintain production at its present level, but to increase it so as to take over dwindling supplies of oil. We may be beyond the point of easy return. Gone are the days when men worked for a pittance in the mines or when environmental despoliation by tips and acid run-offs were the proud signs of industrial prowess.

The National Coal Board is pinning a good measure of its hopes for increased productivity on a hitherto untapped source of coal around the cathedral city of Selby in Yorkshire. Nearby they already have a new mine working which uses a conveyor-belt system to bring coal to the surface, and the coal is then taken by rail to the nearby Drax power station. Drax is only half completed, and the proposal is to get at least 10 million tons a year from the Selby coal-field and feed it to Drax, which by then would have doubled in size. But there are snags.

To begin with, the Central Electricity Generating Board is finding itself having to cope, not with excess demand, but with a forbidding slump of around 14 per cent in its electricity sales. Consequently it is shutting down old stations before their time, which leaves it with newer, much larger stations. These modern stations are more efficient in converting fossil fuels to electricity; hence, just at a time when the Coal Board is wanting to up production, its main customer, the CEGB, is needing to reduce output.[2]

Another snag is Selby itself, which is surrounded by excellent farmland. The land is low-lying, with the River Ouse meandering through, and it tends to flood. If the mining goes ahead, the land is likely to subside by up to three feet. That subsidence could make the difference between high fertility and waterlogging, and pumping the water out could lead to greater subsidence still from soil shrinkage. Also the main London to Edinburgh railway line runs across the potential coal-field, and if operations begin, will have to be moved at an estimated cost of £50 millions. In addition, new accommodation for several thousand miners and their families will have to be erected around Selby.

Labour comprises half the cost of mining coal, and even with the latest cutting devices, a large number of men are needed down the mines. Without question, the productivity per man working has gone up because of the new equipment, but at the same time, it makes more and more of the older mines uneconomic. Thus the Coal Board may find itself unable to meet its target of increased overall production unless it is prepared to make enormous investments in new equipment. Will the nation be able to afford the new coal mines at the same time as it is developing North Sea oil and the new SGHWRs? And will the extra coal be needed if electricity demand remains in the doldrums?

As an energy source, coal is certainly not a government favourite, and judging by expenditure in research and development, the government would much prefer nuclear power to take on the lion's share of generating electricity in the future. But if we look at the pattern of the past, in which each new source of energy takes over easily from its predecessor like oil from coal, then it is evident that nuclear power does not possess the necessary qualifications. Despite the government's claim of its relative cheapness compared to fossil fuels, it is in fact far more costly. Indeed, whereas North Sea oil is some 40 times more costly to extract than oil from the Persian Gulf, nuclear power per unit of energy delivered to the customer is some 20 times more costly than North Sea oil. Part of the reason for the high cost of nuclear power is that its energy must be transduced into electricity to make it useful, whereas coal or oil can be consumed more or less directly. Furthermore the technology required for nuclear power is far more complex than for any other energy system, and one of the basic necessities for any fuel that is to take on the burden of providing energy to an expanding industrial system must be its relative ease of production. It may well be that oil production from such harsh, ungiving environments as the North Sea is already taxing the powers of the industrial system to its limit. How then can nuclear power provide the answer?

New technologies, particularly those as sophisticated as nuclear power, need highly trained people to put them into operation. This fact in itself generates enormous social problems. Areas of the country that are earmarked for construction, whether of a nuclear power station or an oil rig for the North Sea, suddenly become inundated with 'foreigners' with their big pay packets and their demands for amenities. When the construction phase is over, a decade or so later, away go the men and their families, having totally and irrevocably altered the tenor of life of the 'locals'. How then can they return to times when money was not so easy and men had to be more self-sufficient? And what happens to all the construction workers when their own specialised services are no longer required? Do they join the ranks of the unemployed? In fact, phases of growth and expansion followed by slow growth or even levelling off will have enormous repercussions on the workforce. We already see signs of such a happening in Scotland, where demand for oil rigs has fallen short of that predicted only a couple of years back.

Project Independence

The fundamental problem that both industrial and would-be industrial societies must face squarely is that there is no energy source comparable to Middle East petroleum. It may well be that no energy source of the future can take on the burden of meeting world industrial growth, let alone the present level of industrial activity. One consequence of the then four-fold, but since much higher, increase in the price of OPEC oil, as well as of the short-lived but convincing oil embargo of 1973, was to bring on a frantic search for alternatives. The United States responded naturally enough with its 'Project Independence' whereby it would restore its self-sufficiency in energy and would hence regain its freedom of the political machinations of the world's oil producers. Britain responded by rushing even more frantically into the North Sea, the Government having learnt rather crudely from the Arabs that it could claim the oil for itself, despite foreign investment. Both the United States and Britain are learning that their attempts to free themselves from OPEC oil are only enmeshing them still further, for as we shall see when discussing nuclear power, the development of any new major source of energy requires very large energy investments, and where else is a large proportion of that investment coming from if not from OPEC?

Neither Project Independence nor North Sea oil are proving the hoped-for panaceas. When the idea of energy independence for the United States was raised by President Nixon in 1973, it may not have seemed so far-fetched. As economists pointed out, the United States had substantial remaining reserves of petroleum, untapped sources of oil in the Colorado shale and its own uranium. Moreover the OPEC price of petroleum justified the development of more expensive energy resources. To the economists, it was the straightforward story of market forces. What the economists appeared to have forgotten was that energy is not quite like any other resource, since it is the basic resource determining the production of every other substance from potatoes to shoes. Thus, when OPEC oil went up in price, it did not mean, as was naively thought, that other less readily mined sources of energy would become economic;

for those sources were as dependent on OPEC oil for their production as was any other material. Hence, in the North Sea, the cost of developing an oil field shot up to nearly double in less than one year.[3]

But the logistics of Project Independence are as problematic as the finances, and are worth considering in some detail because of their relevance for the rest of the industrial world. At present, the United States produces around 10 million barrels of oil per day from its own oil wells and consumes 17 million barrels. That shortfall of seven million barrels hardly seems excessive and it would appear easily within the realm of American capabilities to increase its home production to meet that demand. Yet first it must be appreciated that all the countries of Western Europe put together consume around 15 million barrels per day and that total world production is in the region of 55 million barrels per day. American imports therefore represent a sizeable percentage of total production. To date America has consumed approximately half its estimated 200-billion-barrel heritage, and at 1970 rates of consumption would get through the rest within 20 years.

Most hypothetical curves of production of a resource over a period of time show the rise and fall as being equal. First comes the phase of exploration, then the peak period of production, and finally as depletion sets in so production falls away. Yet as Hubbert points out in his survey of world energy resources, there is a great deal of difference between an industry which is on the way up and one which is on the way down. The up phase is an ebullient one of hiring men and equipment, and the down phase is one of gloomy discouragement, and a resource is likely to be left in the ground well before the last economic drop can be won. The petroleum industry in the United States is now passing through that phase. According to Hubbert, aside from Alaskan oil, American oil production has already peaked and decline has set in. He has been challenged by petroleum geologists within the industry who claim that extensive exploration will reveal hitherto untapped oil reserves. These geologists base their conclusions on an idea of A. D. Zapp of the U.S. Geological Survey. He proposed that the quantities of oil to be discovered depended on the extent to which exploratory drilling had been carried out, and since by 1959 less than 20 per cent of all the likely petroleum-bearing rocks had been rigorously explored by drilling, 80 per cent more oil was yet to be discovered – which would bring total U.S. reserves both on land and on the continental shelves to more than 500 billion barrels, or over 2½ times the more conservative estimates. Naturally Zapp's estimate was more likely to appeal to the promoters of Project Independence than Hubbert's more pessimistic estimate.[4]

When OPEC oil prices went up.... the cost of developing North Sea Oil was nearly doubled

Just how well has Zapp's hypothesis stood the test of time? According to Hubbert, the rate at which oil has been discovered by exploratory drilling has fallen drastically, indicating that oil finds do not follow a simple arithmetical pattern. Thus, from 1860 to 1920, the average amount of oil discovered per foot for each 100 million feet of exploratory drilling in the United States was 194 barrels; the amount then rose to a maximum of 276 barrels per foot and then underwent a precipitate decline to about 35 barrels per foot by 1965.

Undaunted by these exploration statistics, some petroleum geologists of the U.S. Geological Survey still insist that offshore sites along the eastern seaboard can make a significant contribution to U.S. oil production. H. Warman, BP's exploration manager, is frankly sceptical. "Even if one uses an after-tax netback figure (excluding capital recovery) as high as five dollars per barrel, an average productivity of 1000 barrels per day is required to pay off, without discounting, the initial investment. At current prices/profits," he said, just prior to the Yom Kippur war, "an average recovery of 5000 barrels per day would be required for the same period. Only exceptionally large fields with very good reservoir conditions can meet these requirements. In the United States, average well productivity is 18 barrels per day. Even in Louisiana with its large quota of offshore wells, the average well productivity is only 100 barrels per day. Thus a very large part of the reserves of the United States would not, under any conceivable economic climate within the next two or three decades, constitute a recoverable reserve in the deeper offshore environment." Mr. Warman then added that to quote reserves per unit volume of sediment from a statistical estimate based on the history of American onshore areas "needs very critical analysis as a base for estimating recoverable reserves".[5]

Time seems to have proved both Warman and Hubbert right. Drilling off the coast of Florida and Texas has to date revealed negligible quantities of oil, despite potential oil-bearing geological structures, and one by one American oil companies appear to be abandoning further exploration in those waters. Moreover in May 1975, as if conceding defeat, the U.S. geological survey cut its own 1974 estimates of "undiscovered recoverable resources" of oil and natural gas by about 70 per cent.[6]

With both onshore and offshore petroleum production in mind, the National Petroleum Council hoped that by 1980 the United States would be producing 13.6 million barrels per day. The total included 2 to 2.8 million barrels from Alaska and 1.6 to 2.7 million barrels per day from offshore production. Meanwhile, onshore production was to be boosted to 8.9 million barrels a day compared to actual production figures of 7.8 million in 1972 and an even lower 7.6 million barrels in 1973. Oil experts at M.I.T. reckon that even if it is feasible to reach the 13 million barrels a day target by 1980 it will only be at elevated costs, perhaps even triple the 4.30 dollars per barrel of 'old' American oil.

Just before the October war, American energy forecasters reckoned that U.S. oil consumption in 1976 would be 20 per cent greater than in 1972 simply as a result of demands from the considerable increase of people aged 20 to 25, and that by 1980 at least 25 million barrels per day would be required. Under the best circumstances of 13.6 million barrels per day, the United States would still need to lay its hands on half its oil requirements from external sources – and that in the face of similar rising demands from the rest of the industrialised world.

Shale Oil and the Athabasca Tar Sands – Dream or Reality?

What about the other sources of oil, from shale, the Athabasca tar sands in Alberta, and from coal liquefaction? How much of a contribution can they make to the 25 million barrels a day projected demand? It is at this point, as with projections of nuclear power, that we begin to come across the real constraints of an energy-hungry industrial society. All these energy sources demand an incredible commitment of resources, including an enormously expanded back-up system of rail, refineries, pipe-lines, new housing, and not least, energy itself. As we shall see from the work of Chapman and others on the energy inputs necessary to establish a nuclear energy base, any nation that wishes to raise its energy input to industry and to its inhabitants in general can do so only by first consuming a significant proportion of its total energy – 20 per cent or even more – in creating the necessary energy infrastructure.

The proposals to extract oil from shale or from the Canadian tar sands appear already to have run into severe problems. The largest deposits of shale oils in the world are reckoned to be those of the Green River Formation in Wyoming, Colorado and Utah. Over 2000 billion barrels of oil are locked in the Formation, which covers some 17,000 square miles, but less than one third are in reasonably thick deposits which average more than 25 gallons of oil per ton of shale. Only these better deposits are regarded as being exploitable. Meanwhile the Athabasca tar sands in Alberta cover an area of about 30,000 square miles and contain an estimated reserve of 300 billion barrels of recoverable crude oil.

Even under the best circumstances, by 1980 America will still need to find half its oil requirements from external sources.

At present the only available technology for exploiting the shale and tar sands is to remove the overburden, dig out the oil-coated matrix, and then process it. Ideas have been put forward for *in situ* extraction of both the tar and oil but they have yet to be proved economically feasible. No question that the extraction of oil from shale is a far simpler process than extraction of the bitumen tar from the Athabasca sands. Nevertheless, the cost of constructing a shale-oil extraction plant to yield about 100,000 barrels per day will involve a capital investment of several million dollars, and the oil will have to sell at a minimum of 4 dollars per barrel to give reasonable returns on investment. That makes shale oil some 10 to 20 times more costly than Middle East petroleum, not including the cost of proper environmental reclamation.

The attempt to get oil from the tar sands is a saga in itself, and it illustrates the difference between the geological mapping of a resource and its actual exploitation. The tar sands are located in the frozen Canadian wastelands and temperatures can drop to 45°C below freezing. Much of the area is covered with muskeg swamp which, because of its sludgy properties in high temperatures, can be handled only in the winter. As much muskeg has to be cleared in the winter as will allow a full year's extraction of bitumen, and then the muskeg must be kept from shifting by earth dams. The bulk of the overburden removed after the muskeg operation is used to build 100-foot-high earth dams.

The director of the Great Canadian Soil Sands operation, A. R. Allen, gives a wryly humourous account of some of the difficulties his company has had to face in setting up a pilot plant. In the first years more time was spent in retrieving equipment that had sunk in the muskeg than in oil production; moreover, teeth kept shearing off the excavator after only a few hours' operation and new ones had to be flown in from all over the world; unfrozen water from the warmer depths froze on the buckets, capturing sand, and then proved harder than concrete to remove; and in the summer the bitumen became a sticky, viscous mass which clung to everything, including the conveyer belts.

Many of these technical problems have now been overcome and the plant is producing some 50,000 barrels of synthetic crude oil per day. The process entails the removal of 140,000 tons of tar sand and a nearly equal amount of overburden each day, and after the extraction of the bitumen, the operators are left with material that takes up a considerably larger volume than before. Consequently the new land surface, after filling in with overburden and tailings, is some 70 feet higher than before. Research is at present going on as to the best method of reclaiming the land.

Allen's experience has at least banished any illusions about the Athabasca tar sands as a substitute for Middle East petroleum. In particular, he points out that at the present price of oil, it is unlikely that more than 10 per cent of the total bitumen in Athabasca will be recovered by open-pit mining methods. "This would represent about 43 billion barrels of synthetic crude oil and would take about 100 years to produce from 12 plants each handling up to 400,000 tons a day of solids."[9]

How much does that 10 per cent of the Athabasca deposits represent in relation to United States oil consumption? Just about four years at present rates of consumption, and over the time period stated by Allen, it will not make much of a dent in U.S. needs. Meanwhile a number of more thoughtful Canadians are beginning to appreciate that their country cannot afford to let the United States take over all its mineral resources, as in fact that big neighbour has been doing with undisguised ease over the past 20 years and more. At present, Canada consumes approximately one billion barrels of oil per year, and exports just over one million barrels per day to the United States. Yet at present rates of consumption, Canada has little more than 15 years of conventional oil left in proven reserves, and despite a great deal of talk by ill-informed Canadian politicians and business men of vast untapped reserves of oil and natural gas waiting to be discovered off the Arctic Islands, knowledgeable geologists are far from hopeful. Prudhoe Bays are rarities.

Undaunted, Canadian politicians, advised by such arrant technophiles as Herman Kahn, completely overlook the realities of the situation. A large tar-sands plant costs more than one billion dollars to put in operation, and for Canada to become self-sufficient in oil by 1980 it would require the construction of such an expensive plant every 18 months. Yet according to Kahn, Canada should implement its War Measures Act, and import 30,000 to 40,000 Korean labourers to help get the oil out. Endorsing Kahn's advice and adding to the deceit, Mr. Goyer, Minister of Supply and Services, had this to say:

"There is as much as 20 billion dollars in profits to be reaped in exporting synthetic crude produced from the Alberta oil sands by the end of the decade... the federal and provincial governments and the oil industry must act quickly to capitalise on the oil sands before the United States achieves self-sufficiency by 1980 . . . We have very good customers, eager customers . . . especially the United States, Japan and West Germany . . . The United States should be approached to help develop the oil sands."[10]

Meanwhile the vice-president of Shell Canada advocated that for the next 30 years new tar-sands plants should come into operation at the rate of one a year, and the National Energy Board reckoned that to meet Canadian demands, let alone those of the United States, the tar sands would have to be producing 200,000 barrels a day by 1977, 800,000 barrels per day by 1979, and together with oil from the frontier area, 1.5 million barrels per day by 1983. In utter contrast, Ken North from Carleton University, Ottawa, states emphatically:

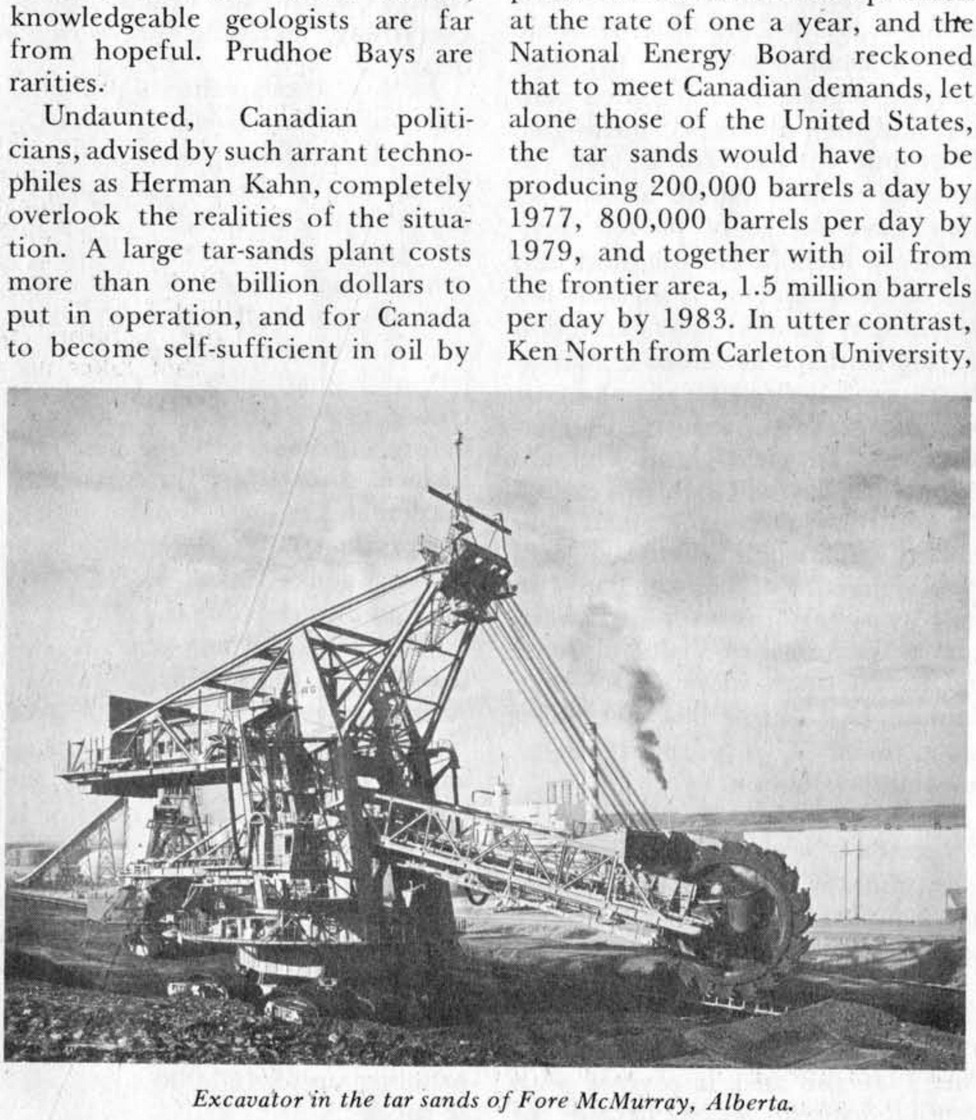
"None of these targets can possibly be met, and everybody in the industry knows it. No commercially exploitable oil has been discovered in any of Canada's frontier areas . . . Even if a Canadian Prudhoe Bay were discovered tomorrow, it would not enable the National Energy Board projections to be met."

As for the tar-sands production, which would require 17 plants in full operation by 1985 at a minimum cost of 20 billion dollars, Dr. North has this to say:

"Such a programme would oversaturate Canada's access to capital markets and our ability to fabricate or purchase steel, cement or electrical components. It would require the services of more engineers, construction crews and machinery than we could possibly manage. No other major engineering undertaking of any kind could be attempted during the duration of this construction, which would bring in its wake terrifying social, economic and environmental consequences."[6]

Realism is at last beginning to take the place of exaggerated optimism. In spite of the arguments put forward against *Limits to Growth* by Maddox, Beckerman and others, no one today believes we can assess the world's mineral resources by adding up all that is to be found in the first mile of the earth's crust. Coal is a good example. It is by far the most abundant of the fossil fuels throughout the world, and yet only a relatively small proportion of the total can be considered minable under present economic conditions and with present technology, as Edmund Nephew shows. Accordingly, in the United States, of a total of more than 3.2 billion tons, less than one eighth will probably be mined. Even so, with a yearly production of around 550 million tons, and 40 billion tons mined to-date, the coal reserves in the United States would last more than 500 years.[11,12]

Yet to achieve Project Independence, coal production would have to increase to 700 or even 800 million tons by 1980, and if President Ford has his way, to 1000 millions by 1988, the intention being that a good part of the mined coal should



Excavator in the tar sands of Fore McMurray, Alberta.

go to chemical plants for conversion into substitute fuel oils and gas. To get quantities into perspective it must be appreciated that 800 million tons is equivalent to some 8 million barrels of oil each day, or to 35,000 million cubic feet of gas, which is approximately half the current oil or gas consumption in the United States. With additional supplies of coal being used to substitute for oil in power stations, it is most unlikely that anything like the total year's production of coal would find its way to conversion plants.

Operational-scale conversion plants are yet to be built, and the coal to fuel them has yet to be mined. A full-scale plant is expected to have a production capacity of some 250 million cubic feet each day of substitute natural gas (SNG) or its 40,000 barrels a day equivalent in syncrude. One hundred such plants would produce only one third of the U.S.'s current gas needs or one quarter of its crude oil consumption. Moreover each plant would cost more than 350 million dollars, to which must be added the cost of building the infrastructure to transport the coal from the new mines.

It has surely become apparent that Project Independence will flounder because of the staggeringly big demand on all the United States' resources. The construction industry will simultaneously be called upon to build refineries, nuclear power plants, coal-mining equipment, syncrude and other coal conversion plants, whale-oil plants, oil rigs for offshore drilling, let alone all the subsidiary industries that follow in the wake of any major enterprise. Skilled man-power will be just one serious constraint. On a 40,000 barrel per day syncrude plant, for example, a contractor will need 500 pipe fitters during peak construction time. Should ten or more such plants be under construction at the same time, then 5000 pipe fitters will be required, all of them probably moving *en masse* into one particular area like Montana or Wyoming, where there are major reserves of coal to be exploited. Nor can any of the capital-intensive energy industries afford shoddy work, particularly not the nuclear industry, where safety and hence reliability of construction are such important factors, and the United States will be hard put to it, to find manpower with the necessary skills.[13]

Materials too will be in short supply; thus a modern oil refinery, just one item, absorbs some 170,000 tons of steel in its pipes and heat exchangers. Fractionating columns, 20 or 30 of which might be required in a one million barrel per day coal-liquification plant, require specialist fabrication, being made at present by a small number of manufacturers working at full stretch.

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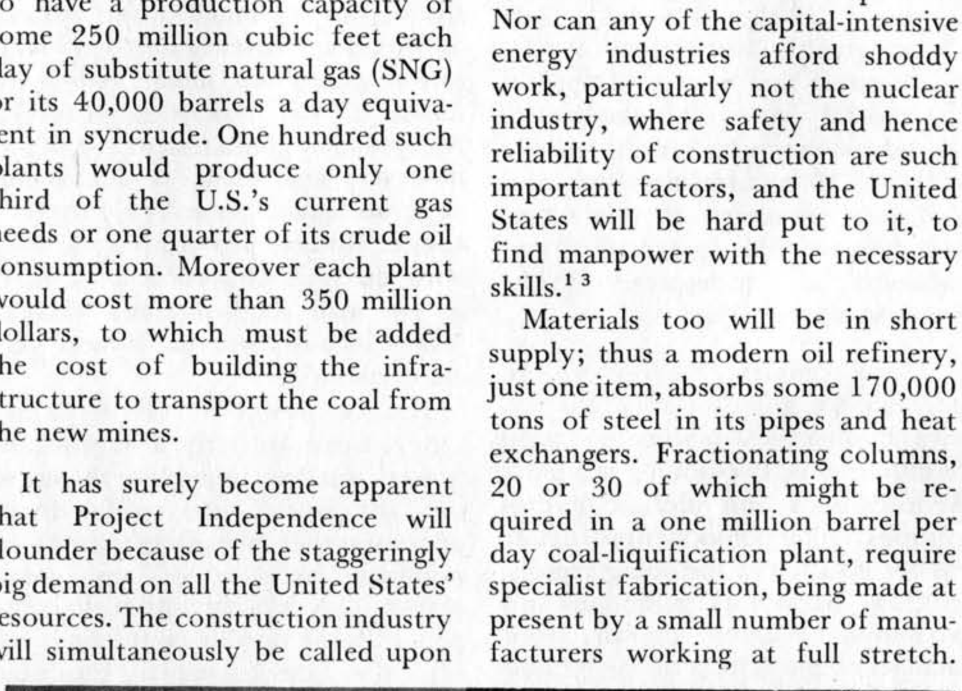

Calder Hall Nuclear Power Station.

If demand does rise, shortages are almost inevitable. The following is a simple statement of some of the absolute requirements during the past decade for the United States to achieve Project Independence:

—Over half a million new oil and gas wells (more than doubling the present number), involving 2,700 new land rigs, 278 drilling platforms, 230 offshore rigs, 73,000 rig personnel, and 87 million pounds of drill pipes;

—more than 60 new oil refineries, requiring 10 million tons of steel and 41,000 man-years of engineering and technology;

—an equal number of plants for oil-shale development and for coal gasification and liquefaction;

—more than 30 new nuclear plants each year;

—more than 140 new coal mines in the east and more than 100 new strip mines in the west;

—plus thousands of miles of new pipelines, both on land and offshore, and half a dozen superports.[6]

Having hardly taken into account these constraints, the National Petroleum Council estimates that by 1985 the tar sands could be yielding from one quarter to one half million barrels per day; shale oil from 100,000 to 400,000 barrels per day and coal around 80,000 barrels per day. Even then, the combined total of some 1.5 million barrels per day is hardly impressive when viewed in the context of a forecast of total demand in the United States of some 29 million barrels per day by 1985.

Energy Production and the Environment

So far we have discussed neither pollution problems nor nuclear power. Pollution is a vast and contentious subject, but it is worth stating that attempts by the United States and the remainder of the world to increase energy consumption can lead only to a rapid and probably uncheckable deterioration of the environment, especially as the margins of profitability dwindle away with rising costs and inflation. The watering down of the Control of Pollution Act in Britain almost as soon as it was drawn up in 1975, as well as Britain's refusal to accept the more stringent environmental laws of the Community, are typical responses to a worsening economic situation.

Should the United States pursue its options for achieving Project Independence, the environmental upheaval will be immense. Much of mid-western coal, as well as shale oil and bitumen tar from the Athabasca sands in Canada, will be strip-mined. Also, a large pro portion of America's coal at present comes from Appalachia, where slopes of 20 degrees and more are encountered. Annual erosion from freshly strip-mined areas is as high as 27,000 tons per square mile or up to 1000 times greater than for undisturbed land. If, as has been recommended, a ban should be imposed on strip mining slopes greater than 20 degrees, it would mean a cut-back of some 15 per cent of total U.S. coal production. Strip mining leads inevitably to ground water contaminated with acids, heavy metals and even carcinogens; marked deterioration in aquatic life downstream from the mine is incontrovertible evidence of pollution. According to Nephew, strip mining for coal in the west and south-west may give rise to even more recalcitrant reclamation problems because of the low rainfall and the very fragile environment. Lack of water in such regions will also limit the establishment there of coal-conversion plants, and will necessitate building a rail link-up to some area where water is more abundant.

With increased consumption, inevitably coal with a high sulphur content will have to be used. If the sulphur emissions were not controlled, then according to the American Public Health Association, this extra pollution alone could lead to an extra 13 to 14 thousand cases of respiratory disease in children under five and about 12 thousand additional deaths of people over 60, not to mention chronic disease which is not easily attributable to any specific cause. As it is, the Environmental Protection Agency estimates that air pollution by sulphur emissions does about 8 billion dollars worth of damage in just one year. It is also worth mentioning that Britain has one of the highest records of chronic bronchitis and other respiratory diseases in the world, much of which can be attributed to the sulphur emissions from coal burning.

The transportation of oil across the world, together with waste oil runoff from land, leads to widespread pollution of the oceans. In any one year the total annual influx to the ocean lies between 5 and 10 million tons, and not only are lumps of crude oil found on most beaches of the world, but oil can also be found in the stomachs of surface-feeding fishes and in marine plants. The spread of oil from a spill area to encompass a much larger area of ocean is insidious and inevitable. According to Max Blumer[14] of the Woods Hole Oceanographic Institution, a relatively small and restricted spill in the coastal water of Massachusetts spread, nine monghs later, to an area covering 20 square kilometres and 2 square kilometres in tidal rivers and marshes. This spread of oil was followed by widespread deaths amongst all species.

Three complex fractions are responsible for much of oil's toxicity, says Blumer: low-boiling saturated hydrocarbons, low-boiling aromatic hydrocarbons and olefinic hydrocarbons. Other components of crude oil are also toxic, including cresols, xylenols, naphthols, quinolines and pyridines. Blumer claims, from analysis of the effects of the limited oil spill in Massachusets, that the toxic effects of oil have generally been underestimated. Indeed, nine months after the incident the affected areas had not been repopulated, and animals such as mussels that survived the spill as juveniles developed no eggs and sperm. Also, the oil contains many different carcinogens, as was indeed appreciated some years ago on account of a relatively high rate of skin cancer among refinery personnel. Working conditions as well as plant design have since been improved, and the cancer rate among such workers is no longer above normal. Nevertheless, skin contact with tars on beaches combined with sun bathing, as well as the consumption of fish contaminated with certain carcinogenic oil fractions, must surely be something of a health hazard.[14]

Nuclear Waste

Many of the problems associated with the production and consumption of fuels become magnified with nuclear power. Thus nuclear power demands highly sophisticated technology backed up by brilliant science; it needs enormous inputs of capital both in research and in building operational plants; it cannot afford gross malfunctions and the margins for error are far lower than for any other major industry; and per kilowatt of energy produced, it yields a waste many thousands of times more toxic than that produced by the combustion of fossil fuels. Hence nuclear power stations cannot discharge their wastes through the chimney or into water, as would a conventional fossil-fuel power plant, but must contain as much of the wastes as possible. No system of containment is perfect however, and waste is discharged at levels agreed upon by an inspectorate. Nuclear power presents man with the ultimate problem of what to do with the contained wastes. Where to put them and how to get rid of them?

Nuclear power is still in its infancy; there are only a handful of power stations operating throughout the world, and so far their operation has not given rise to a pollution problem of any great magnitude, certainly nothing to compare with the terrible contamination of the environment resulting from the combustion of oil and coal. Sir John Hill, chairman of the U.K. Atomic Energy Authority, predictably enough believes that nuclear power presents no great problems for mankind. In a recent speech, he suggested that a major reason for public antagonism (where it existed) to nuclear power originated because of its discovery by scientists in the laboratory, and because of its association with the bomb. He claims that if combustion of fossil fuels had also been discovered by scientists, who had invested the phenomenon with scientific jargon and formulae, then the public might have reacted equally against their use.

"I like to regard," he says, "the burning of coal or the burning of uranium as alternative ways of producing heat – and by burning I mean turning into something different and giving out heat in the process. If we start from this basis it would remove from the debate a lot of the unknown and the science which is incomprehensible to the layman."

Sir John Hill may possibly reassure laymen and some scientists by his suave statements, but he certainly has not been able to reassure all scientists, including nuclear physicists and radiation biologists, who take a very different viewpoint about the wisdom of embarking on a major nuclear programme. In fact, the similarities between a conventional fossil-fuel power plant and a nuclear power plant are certainly outnumbered by the differences. Thus if coal or oil are stolen from a power plant, it is a straight case of theft. If enriched uranium or plutonium are stolen, the theft could have much more sinister consequences. As Amory Lovins and others have pointed out, it does not need the letting off of an atomic bomb to do a great deal of harm; conventional explosive packed with plutonium or some other radioactive material will achieve something of the same purpose. In this respect it must be realised that a few ten millionths of an ounce of plutonium can, if inhaled, cause lung cancer. Hence a sufficient dose to wipe out all the world would be contained in a mass of plutonium not much bigger than a marble – and once the nuclear programme gets off the ground, several hundred tons of this substance will be produced each year.

Nor is it idle talk to discuss the possibility of plutonium thefts from nuclear power plants. The International Atomic Energy Agency, in common with other nuclear fuel experts, reckons it an impossible task to make an inventory of the plutonium generated in a nuclear power plant that is more than 99 per cent accurate. A loss of one per cent here and there, when many large 1000-megawatt reactors are in operation, would soon lead to enough plutonium for the manufacturers of atomic bombs. In today's world, anything can happen.

Sir John Hill is wrong to assume that near 100 per cent containment of the wastes from a nuclear power station solves the problem. It may be a temporary solution, but as has been well described in recent press reports, the world will soon have to find safe storage for billions of curies of radioactive waste, with some of that waste having to be kept out of the living environment for many hundreds of thousands of years. Another nuclear energy expert – who has been an advocate in the past – shows a little more concern than Sir John.

"Thus we seem to have struck a Faustian bargain," says Alvin Weinburg, ex-director of the Atomic Energy Commission-supported Oak Ridge National Laboratory in Tennessee. "We are given the miraculous fire – whose dimensions I saw only dimly 18 years ago – as a means of producing very clean and, with the breeder, inexhaustible energy. The price that we must pay for this great boon is a vigilance that in many ways transcends what we have ever had to maintain: vigilance and care in operating these devices and creation, and continuation into eternity, of a cadre or priesthood who understand the nuclear systems, and who are prepared to guard the wastes. To those of us whose business it is to supply power here and now, such speculations about 100,000-year priesthoods must strike an eerie and unreal sound . . . But the immediate concern for vigilant, intelligent, and responsible operation of nuclear power plants is not theoretical nor remote. It is a heavy responsibility that everyone in the utility industry, public and private, must assume."

It needs a biologist, Nobel laureate J. T. Edsall, to put in proper perspective the utter impossibility of Weinberg's call for an eternal priesthood, which in his words, "exceeds Pharaoh's time scale 10- or even 100-fold." Thus Edsall states that "my own judgement is deeply influenced by my general estimate of human nature and behaviour, and by my reading of history. People have to operate nuclear power plants, no matter how much automation we introduce. People are forgetful, often they are irresponsible, and quite a few of them suffer from deep-seated irrational tendencies to hostility and violence. I believe that the confident advocates of the safety of nuclear power plants base their confidence too narrowly on the safety that it is possible to achieve under the most favourable circumstances, over a limited period of time, with a corps of highly trained and dedicated personnel. If we take a larger view of human nature and history, I believe that we can never expect such conditions to persist over centuries, much less over millenia."

But to return to Sir John's statement that fossil fuels and uranium should be viewed as little more than two different ways of generating heat – with uranium having the distinction of liberating approximately one million times more calorific energy than an equivalent quantity of coal – he fails to give credit to the manifold difference in chemical structure. Thus the fossil fuels are extraordinarily complex organic compounds that can be used in all manner of useful transformations, while uranium, except for its potential to bring about the transmutation of elements into such substances as plutonium, is of much less importance chemically. To attempt to use nuclear power to fulfil the role of the fossil fuels as chemical feedstocks would necessitate the consumption of a great deal more energy in synthetic reactions. Some such reactions have already been proposed. Thus hydrogen could be generated by the electrolysis of water and used either as a fuel or as a reducing agent in the synthesis of nitrogen fertilisers and steel. On a world-wide scale, such syntheses would necessitate yet another rise in energy consumption, and if carried out extensively, could lead to disturbances in the earth's thermodynamic equilibrium, as we shall see later when discussing world energy limits.

Nor do fossil fuels have to be transduced, as must nuclear power, into a secondary form of energy, such as electricity. Thus nuclear power stations lead to greater centralisation of energy production, and hence make the system more vulnerable than it ever was to strike action or even to simple breakdowns. Even now electricity workers can bring about manifold disruption of society within hours of striking, compared to the weeks required by coal-miners or OPEC, and once society has become almost wholly electrified — as is proposed — its vulnerability will be complete.

Another disadvantage of nuclear power stations is that their economics (though not necessarily their reliability) improves with size. The power stations now under construction are all in the range of 1000 megawatts, which is five times bigger than the power stations in operation ten years ago. While such addition of power may be acceptable to an industrialised nation such as Britain, it may be less satisfactory for a developing country which anyway has a low energy base. And what would happen in such a country if the one major contributor to the grid breaks down or needs an overhaul?

Being a promoter of nuclear power, Sir John does not pose the question whether we really need more power in Britain and what we propose to do with it when we have it. In one respect, he is certainly correct; as sources of energy, there is not so much difference between fossil fuels and nuclear power in effecting changes in our environment. Once energy is used above a certain level, it unavoidably pollutes and destroys, as Ivan Illich has pointed out with admirable clarity in *Energy and Equity,* and in Britain it should be apparent to everyone that we have already exceeded that limit long ago. That our relatively high energy consumption has not brought about equity is one of the more crude paradoxes of our time. Indeed, throughout the ages and still manifestly so today, the consumption of energy beyond human basic need has always led to the exploitation of one group of people by another. The ancient Egyptians used their energy surplus to feed their 'megamachine' of hundreds of thousands of human slaves, and were able to establish an autocratic hierarchy. Today, in industrialised countries, we tend to use power machines rather than human labour, but the end result is not so dissimilar from ancient Egypt. We too have a hierarchy based on wealth and on our position in industry. Our monuments just happen to be enormous office blocks rather than pyramids.

In the end, ancient Egypt collapsed because its over-bureaucratised system became too unwieldy and degenerate and was no longer able to manage the country's energy base of human slaves. In all probability, a similar fate awaits us. The energy base we depend upon is gigantic and to integrate a new energy source into it, such as nuclear power, is a Herculean task, with just about as much point to it. Furthermore, we are now discovering, through the work of Peter Chapman and his colleagues at the Open University, as well as of Amory Lovins and John Price at Friends of the Earth, that an all-out programme to develop nuclear power may actually absorb nearly as much energy as it can generate because of the high initial capital and energy costs. Thus, to embark on a nuclear construction programme with the aim of overcoming short-term energy deficiencies or of replacing OPEC oil may have the unforeseen effect of increasing the energy deficit or alternatively of increasing, for some years, the dependence on petroleum.[16 17]

Nuclear Programmes

Practically all industrial nations have programmes under consideration for developing nuclear power. In 1974, the United States Atomic Energy Commission expected nuclear-installed generating capacity to increase 12 to 15 times by 1985 and 3 or 4 times more between 1985 and 2000. Meanwhile, France and Japan were considering doubling the number of reactors every two years or so, and Britain every 4.3 years. Although their calculation is far from complete, Chapman and the other energy analysts estimate that present-day nuclear reactors are able to generate some 10 to 15 times more energy in their 25-year lifetimes than they consume in their construction, maintenance and fuelling. The uranium fuel is assumed to come from high-grade ores yielding 0.3 per cent uranium oxide by weight.

That, then, is the static case. However, the picture changes remarkably during a dynamic growth phase when many reactors are under construction at the same time. In contrast to fossil-fuel power plants, nuclear reactors need a very high initial investment, both because of the high quality demanded in engineering and materials, and because of the fuelling with enriched uranium. Indeed, as Chapman points out, the use of lower-grade ores, like the Chattanooga shale with 0.007 per cent by weight uranium oxide, completely alters the overall net energy gains from a reactor, reducing them by half or more. Equally relevant, since it imposes a limit on the useful deposits of uranium, is that any ore like Cornwall granite, or for that matter sea water, containing less than 20 parts per million, cannot provide a net income of energy, since the process of extraction and enrichment will be too energy-demanding.

Chapman and Price have assumed a reactor construction time of five years, with one additional year being needed for commissioning the plant. In an exponential growth phase, the number of reactors started will outnumber those completed. Thus, in a programme with a doubling time of two years, seven times more stations are under construction than are completed. Given a net energy deficit of 4,823 million kilowatt-hours (thermal) per year for each station finished, then when ten stations are finished, the net energy deficit will be ten times greater. At the end of the building programme, the deficit can amount to a significant proportion of total energy output. How big a proportion will depend on the final number of power stations constructed.

"In the British case," says Price, "with reactor population proposed to double every 4.3 years or so, and assuming high-grade uranium ores fuelling SGHWRs (the reactor system now chosen by the U.K. government), only about a third of the energy which the programme is supposed to produce would actually be left over for general use after reinvestment in the programme. This can be interpreted as meaning that to meet a given final demand by society in general (excluding the nuclear industry), about three times as much capacity must be built as was expected; alternatively, that a unit of net output to society from the nuclear programme will cost about three times as much as had been claimed. With uranium from low-grade ores (Chattanooga shale), it is likely that a sustained programme of SGHWRs with a 4.3-year doubling time would always be a net consumer of energy: the more reactors we build, the more energy we would lose."

Various issues have arisen out of Price's energy analysis. Leach and others have pointed out that when the nuclear building programme is complete it will produce a net surplus which will more than cover its energy costs. Also the conversion of fossil fuel into electricity is an inefficient process, some four units of fossil-fuel energy producing one unit of electricity for consumption. Leach has stated therefore that nuclear power, with its overall energy ratio of more than 10, is not simply a better bet for electricity production, compared with fossil fuels, it also frees fossil fuels for other purposes, including chemical conversions into consumer items.[18]

Price makes some valid points in reply. First, by committing ourselves to nuclear power, we are effectively borrowing a high-grade, low-cost energy source, OPEC oil for example, in order to establish a system fuelled by a lower-grade but higher-cost energy source. We will probably find it very difficult, therefore, to pay back the energy debt, especially when we are forced to use lower-grade uranium ores and the more marginal North Sea oilfields. Second, the surge in power available to customers, when a nuclear programme has been completed, will come at an embarrassing time. For now, the construction industry, which had been hard put to build reactors, will find itself facing a terrible slump, and as Price says "demand will drop at the moment of maximum output". The situation is further complicated by the need to begin the construction cycle all over again as each reactor reaches the end of its lifetime. Thus, unless surplus reactors are built above and beyond those actually needed to meet projected consumer demand, a country with much of its energy provided by nuclear reactors will suddenly find itself undergoing periodic and substantial energy shortages as construction begins anew. Such disturbances can be more or less avoided with fossil-fuel power plants because of the much smaller energy investment required during their construction, and because they are fuelled continuously rather than all at once as most occur in the reactor.

The other point, that electricity generation using fossil fuels is wasteful and it is therefore better to use an alternative fuel source such as uranium for these purposes, is based on a misunderstanding of the basic issues. Such a claim would only be true if the uranium itself were not consumed during the fission process, but in thermal reactors, at least, the conversion of the potential energy of uranium to electricity is no more than one per cent efficient compared to the 20 per cent achieved with the fossil fuels. However, if the purpose is to minimise the use of fossil fuels in electricity generation then, says Price, "thermal nuclear reactors are probably a considerably more efficient way of converting coal to electricity than are coal-fired power stations . . ."

In theory, breeder reactors should overcome the inherent inefficiency of thermal reactors, since by breeding plutonium from the otherwise unusable uranium-238, which comprises more than 95 per cent of all uranium, they produce as much fuel as they consume. For this reason, Sir John Hill and the Atomic Energy Authority believe that the breeder-reactor programme should be begun as soon as possible. Yet similar constraints exist for a rapidly expanding breeder-reactor programme as for thermal reactors. It takes some 20 years or more to breed sufficient plutonium to stock an equivalent-sized breeder reactor, hence their doubling time must perforce be several decades unless plutonium can be supplied from a vast thermal-reactor programme, or from the dismantling of plutonium warheads. Thus, just as thermal reactors cannot supply their own energy investment if built at a rapid exponential rate, so breeder reactors cannot provide the necessary plutonium to sustain a reasonably rapid growth programme, although individually, thermal reactors produce a net energy output, just as breeders produce a net plutonium output.

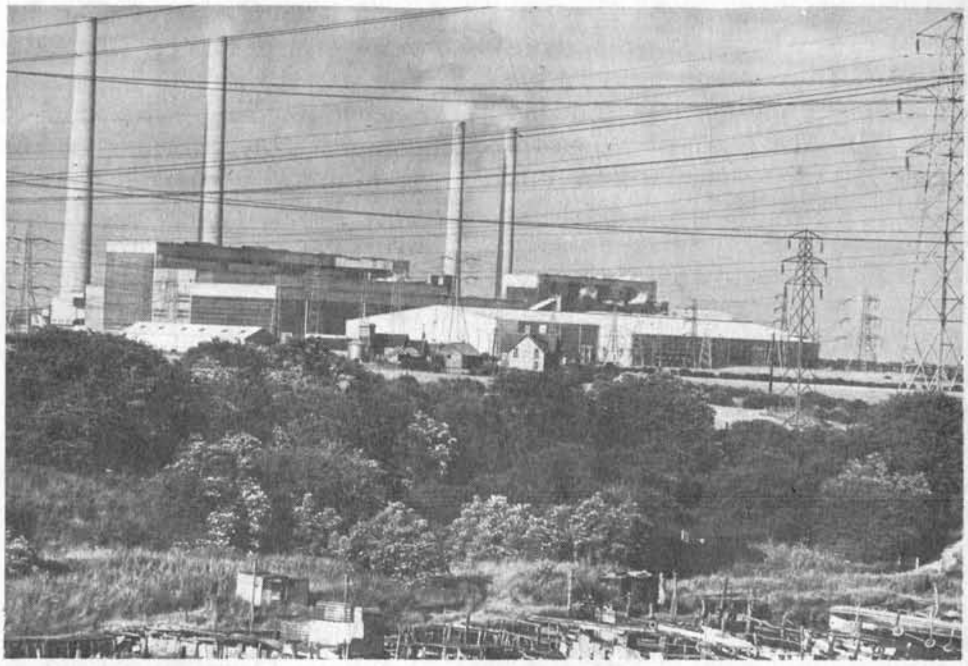
Photo: Barnaby's Picture Library

Blyth Power Station, Blyth, Northumberland.

By studying the dynamic, as well as the static situation, Price and his colleagues seem to have shown beyond reasonable doubt that it would be both economic and energy suicide to embark, at this stage, on a large-scale nuclear-power programme. They therefore have raised the issue as to whether it is wise to continue to expand the use of electricity in our society.

In fact, it is only recently that people have begun to appreciate the overall inefficiency of electricity, as used at the present time in Britain. Thus electricity is increasingly used for space heating, which means that a fuel of high-grade thermal energy, such as coal or oil, is converted very inefficiently into low-grade heat. As Chapman points out, exactly the same amount of heating can be provided by directly using a third of the quantity of fossil fuels needed for the electrical system. Indeed, if instead of electrical space heating, British consumers used a primary fuel direct, the overall saving would be some 4 per cent of total primary energy consumption. Admittedly, electrically driven motors are as efficient as the internal combustion engine, and certainly more pleasant to use, since they are fumeless and relatively quiet.

Ironically, as society has become more highly industrialised, so its use of energy has become more inefficient. Thus, although total gross energy consumption has doubled since 1900, the end use by the consumer has only increased by one half (or one third per capita). As Lovins states, the rest of the energy has been swallowed up by industry, and the energy industry in particular, and he suggests, in consequence, that we should look for more appropriate technologies to give us better returns. But it is not just appropriate technologies that we should be looking for. Increasingly, our industrialised society has turned itself over to the production of waste, combined with an unthinking extravagance in its use of energy-consuming devices. Thus the United States has to spend six billion dollars on waste disposal, and Britain a comparable per-capita amount. The wastage in food alone is inordinate, some 25 per cent of all food produced in Britain getting dumped and at least 15 per cent of that produced in the United States, according to the findings of archaeology students who went on a 'dig' of a rubbish tip.

Our society is now at a critical point. Our energy options are closing fast, as the fossil fuels, which take the brunt of supplying us with primary energy, are becoming increasingly scarce or less accessible. Nuclear power seems to be a non-starter. Moreover, the public, which in the past has accepted fossil-fuel power stations, seems less and less prepared to take nuclear power as an energy option. In the United States, both public opinion and breakdowns have combined to bring about a fall from grace of nuclear power. Indeed, orders by the electricity-generating utilities for nuclear reactors fell from a peak of 36 in 1973, to 27 in 1974, to a dismal low of 5 in 1975 when plans for 24 reactors were cancelled or deferred. Another nail in the coffin of Project Independence.[19]

Public Protests

In countries such as Britain and France, where decisions to build nuclear power plants are made by the government and not by private industry, it is somewhat easier to ride roughshod over public opinion – under the guise of putting the national interest above all other concerns. Yet in France, where the government is trying to implement a much more aggressive nuclear programme than in Britain, public antagonism is becoming daily a stronger force. Thus two nuclear power plants under construction – Fessenheim on the Rhine and Bugey on the Rhone – have been besieged by anti-nuclear groups for several years, with measurable success in organising local opposition and bringing about delays in completion. Indeed, in May 1975, two bombs went off at Fessenheim damaging equipment for the reactor. A strong protest group has now developed in Nogent-sur-Seine, 60 miles to the south of Paris, where EDF, the French State Electricity, has plans to build a 5000-megawatt nuclear power station. Already it seems as if EDF are having to look for alternative sites.[20]

The boiling-water reactors and pressurised-vessel water reactors used in the United States have recently been bedevilled with problems. In 1974, for example, there were 1400 incidents of malfunctionings in light-water reactors, and certain components were found to be substandard. Controversy still rages over the emergency core-cooling system which must be brought into play automatically in LWRs if there should be any major rupture of pipes carrying coolant to the intensely hot reactor core. The discovery of cracks in similar pipes to those carrying coolant in a number of BWRs – causing the shutdown of all BWRs in the United States – hardly creates confidence in the reactors, either within or outside the industry.[1]

As has been shown time and time again, it is the unpredictable event that brings out the major faults and makes any assessment of safety something of a futile exercise. Who could ever have predicted that a major fire in a nuclear power station in the United States could have been caused by a worker checking a fault with a candle? One man later assessed the probability of such an occurrence as a negligible ten millionths of a millionth (10^{-13}).

In making their energy analyses, Chapman and Price have purposely neglected to assess the process and investment requirements for transporting, treating, storing, retrieving, safeguarding and disposing of high-level wastes. As Price states "the disposal technologies are still speculative, as is the appropriateness of the storage notions proposed. In the absence of credible disposal methods, one might calculate the energy which would be required for long-term storage, if it were to rely on the methods that are now proposed for interim storage (for periods ranging from a few decades to a century): over the very long periods required, these energy outputs would be comparable to, or would exceed by as much as about an hundredfold, the lifetime gross output of the reactors served."

It is quite evident that the promoters of nuclear power, including governments, are not only giving themselves the right to produce highly toxic wastes that will have to be safeguarded, willy nilly, by future generations, but they are doing so without having yet devised a suitable technology for their safekeeping, and equally pernicious, without really knowing whether future generations will have available the quantities of energy necessary for that safe-keeping.

Another unknown, towards which we are progressing blindly and somewhat incautiously, is the earth's thermal limit. Certainly, even with our industrial processes, we give out a lot less heat than the earth receives from the sun – in fact about 1/20,000 of the total solar energy intercepted by the earth, or 1/5000 of the total energy received by the earth's land mass. Yet the energy man consumes, which in the end finishes up as low-grade heat, is by no means a paltry amount when we appreciate that already it is on a par with the energy absorbed by all terrestrial plants in photosynthesis. Thus man's energy requirements are now as great as all terrestrial organisms put together. Moreover, the energy man consumes is not a static amount, but has been growing rapidly, and within 50 years, if current trends continue, could amount to one per cent of the solar input to the earth.

If the earth were a lump of rock, with no oceans and air masses to absorb heat and bring about climatic processes and weather changes, then within 70 years the earth's surface temperature would rise by 0.7°C, sufficient in theory to melt the polar ice caps. As it is, the process is far more complicated and no one has very much idea what would happen. Thus, if the ice cap started melting, the earth's reflectivity or albedo would change, with even more heat being absorbed by the polar oceans than before, so increasing the rate of melting. If all ice caps melted, the oceans would rise some 300 feet, washing away wholesale man's industrial enterprises and destroying a large percentage of good agricultural land. On the other hand, increased heat would probably increase cloud cover, and hence reduce the solar radiation reaching the earth's surface. Also confusing the issue would be the hot-house effect of increased carbon dioxide from fossil-fuel burning, and the cutting out of solar radiation by increased dust in the atmosphere as a consequence of man's activities on the earth's surface. Even if man never reaches the one per cent solar input level, in certain areas he now far exceeds it, bringing about local disturbances of climate and weather. Thus the 4000-square-mile area of Los Angeles gives out man-made heat equivalent to 5 per cent of solar input, and by the year 2000 it is expected to rise to 18 per cent. Already Greater London has achieved 18 per cent, and the centre of London is therefore between 3 and 7°C warmer than the surroundings.

Chapman has shown that the total fuel consumption in Britain has already topped one per cent of solar input, and hence if a limit were put to confine man's activities to this level, we in Britain would be at our heat limit. However, as he argues, man lives on little more than 10 per cent of the world's surface area, and therefore the limit could possibly be raised to 10 per cent of solar input without triggering off a major climatic change. A more equitable solution, he suggests, would be to allocate energy consumption on a world-wide basis so that each individual had at his disposal the equivalent of 20 kilowatts. At present, Britain has an average fuel consumption of 5 kw per person, so on that basis we should be able to increase our average per-capita consumption fourfold.

Man's energy requirements are now as great as those of all other terrestial organisms put together.

In fact, it is hard to take even a possibility of a fourfold rise in average energy consumption at all seriously. We are already in trouble economically because our fuel has begun to cost a great deal more than it did just a few years ago, and even more telling, there is very little evidence that we, as individuals, are actually better off because of our access to large quantities of energy. Has our food improved because we each of us need to consume the equivalent of nearly one ton of oil in its production? And has our access to other people, in particular our friends and families, really improved because of the motor car, or have we in fact created a new kind of distance between ourselves and our fellow beings? Nor is there much evidence that our health is greatly better because of the enormous growth in medical services over the past 20 years or so, or that our society is more contented and less violent than it was in the past.

Surely, rather than spend our time worrying about the limits to growth, whether energy constraints, thermal constraints, or even social constraints, we should be searching for ways to rehabilitate our society, and that rehabilitation would naturally involve living much more within our means. All the present trends are towards social chaos. Small-scale, even family, enterprises are being wiped out since our government now gives its support to monolithic, large-scale 'nationalised' industries, which in order to achieve greater productivity must replace men with automated machines. Thus we have Varley, Minster of Industry, claiming that the recent agreement between BSC and the trade unions for a further cut in manpower means that at last we will have "an efficiently manned and competitive steel industry". He simply seemed to accept, as a fact of life, that it is better to have industrial productivity than men happily employed. On the land too, we are seeing the beginning of a further reduction in the already puny work-force because farmers can no longer afford labour. Instead, they must resort even more to large energy-consuming machines, hence reducing further the actual efficiency of farming.

Without question, energy can be saved by relatively simple energy conservation measures, such as by insulating houses, by cutting back on the use of cars – particularly by the commuter driving on his own, by reducing the packaging of goods, by recycling materials, and by limiting the use and proliferation of electrical gadgets for the home. In addition, society can make much better use of alternative energy sources such as the sun. Because of the multifold increase in fossil-fuel prices, it now makes both economic and ecological sense to fit solar panels to houses to supplement the conventional heating system, and enterprising individuals, such as Robin Clarke, have shown that the investment can be paid off in a couple of years.

Although the sun is an attractive source of energy, it will certainly tax the manufacturing industry beyond its present capabilities to provide solar devices on a mass-scale. Again, Chapman has done some of the basic calculations. "To convert all 18 million houses to solar heating requires some 3.25 million tons of aluminium – which is about one third of the present world production of aluminium. Even allowing the conversion to be spread over a long period produces problems. At the peak of the conversion programme, corresponding to 700,000 houses per year, the material demands would use up half the U.K.-produced aluminium, almost three quarters of the U.K. sheet-glass production and more than twice the U.K. copper production."

And even if, by some miracle of production, the manufacturing industries were able to churn out sufficient solar devices, it must be appreciated that, compared to our present consumption of energy, the total contribution that all such devices could make would be relatively small. Thus the Energy Research and Development Agency of the United States estimates that for a "standard" American house of some 1,200 square feet, a solar-heating device, which on average would supply no more than 50 per cent of the house's heating requirements, would cost somewhere in the range of 5000 to 10,000 dollars, compared with around 1000 dollars for conventional heating devices. If by the year 2000, one third of all housing – new and old – were fitted out with solar devices, then according to ERDA, the total energy saving would be approximately 2 per cent of the country's energy needs.[21]

Problems also arise using other alternative sources of power such as geothermal energy, which is not only limited in scope and a resource that depletes rapidly on exploitation, but can give rise to serious environmental problems, including the triggering off of earthquakes and the release of high-toxic minerals.[22] Moreover, in Britain, other alternative sources of energy, such as hydro- and tidal-power, are also relatively limited and at best can provide only a small proportion of our present energy requirements.

If Britain and the other industrialised nations wish to commit themselves further to the cause of industrialism, they can do so only by enormous investment in energy production processes, whether of conventional oil, coal, or nuclear power. Even then, as we have shown, they are likely to fall short of meeting their projected energy demands because of limited capital and limited resources of materials and skilled man-power. In addition, an exponentially growing nuclear-power programme may be an actual consumer, rather than producer, of energy. And even if the industrialised nations do manage to come up with the extra energy, there is no guarantee that the consumer will be able to afford it, and if the energy is given away, like butter or beef from the EEC stockpiles, someone somewhere will have to foot the bill, and who but OPEC will have that sort of money to throw around?

Britain is thus poised on the brink, and looking at the cards, it would seem utter folly to gamble on energy. The sensible solution is to turn right away from the high-energy society and look very hard and seriously for ways of living well on what we really can afford from our own fertile land. There can be no denying that to achieve a non-consumer society while maintaining a high standard of social care for everyone, including the old and sick, will necessitate something of a social revolution.

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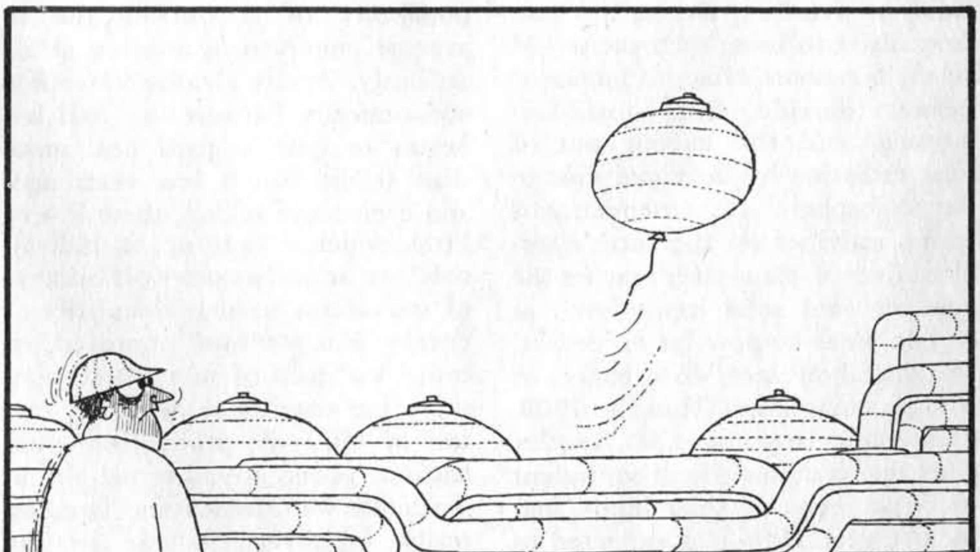


About Concorde

"…. man has a solemn responsibility to protect and enhance the environment for future generations"

UN Declaration at the Stockholm Conference 1972

In Britain and France, as in most other Western European countries it is recognised that the supersonic BANG is intolerable and therefore unacceptable, and yet Britain and France continue to press for supersonic routes over the countries of Africa, Indonesia, India and the Middle East irrespective of the environmental consequences, health hazards and disruption to the people of these countries.

On its inaugural flight CONCORD noise level was 134 PNdB (Perceived Noise Decibels) — **Well above the level of pain** — and described by those whose homes lie in its flight path as "excruciating" and "murderous" (Maximum permissible noise level for departing aircraft at Heathrow is 110 PNdB by day, 102 PNdB by night).
CONCORDE is as noisy as 8 Boeing 707s flying overhead with a noise footprint extending over an area 41 times that of a DC 10.

Figures from SERA (Socialist Environment & Resource Association)

The manufacturers of CONCORDE have spent **seven years and £40 million** attempting to bring its Airport Noise Level down to an acceptable level without success. Even the Chairman of B.A., (in a letter to Toby Jessell, M.P. dated 29.10.75) admits that nothing more can be done.

To date, CONCORDE has cost £1,096 million pounds. At its present level of operation it can only continue to lose further vast sums of money. To be commercially viable it would have to fly at least two round trips on the transatlantic route every day of the week, every week of the year.

In a single Atlantic crossing CONCORDE burns its own weight in fuel [ie: 68 metric tons of kerosene]. If it flies the Atlantic route four times a day the annual consumption of fuel will be 100,000 tons.

While new models of conventional aircraft have become increasingly quieter CONCORDE's noise, even at subsonic speeds exceeded the legal noise limit on seventy per cent of its trial flights.

"SUPERSONIC BANGS can be heard inside other aircraft flying below it and can disrupt readings on pressure instruments, thus causing pilots to suspect something amiss in their own aircraft."

Article in FLIGHT, 31st January 1976

CONCORDE AND AIR POLLUTION
The mass of catalysts sufficient to destroy stratospheric ozone at a significant world wide rate is less than the mass of the annual waste products from several industrial operations. **In particular the mass of nitrogen oxides from the exhausts of 500 supersonic transports is far above the threshold for significant catalytic destruction of ozone.** This could have profound effects on the working and very maintenance of the biosphere.

Pollution of the Stratosphere by Harold Johnson Ph.D. (Cal. Tech) Environment Conservation Vol 1. No 3. Autumn 1974

"The level of carbon monoxide emission from CONCORDE is four times that of B-707 and more than four times that of a 747 (which can carry four times as many passengers) and almost seven times that of the DC-8."

Richard Wiggs, Secretary, Anti-Concorde Project

"CONCORDE would create a serious danger of increased incidence of skin cancer"

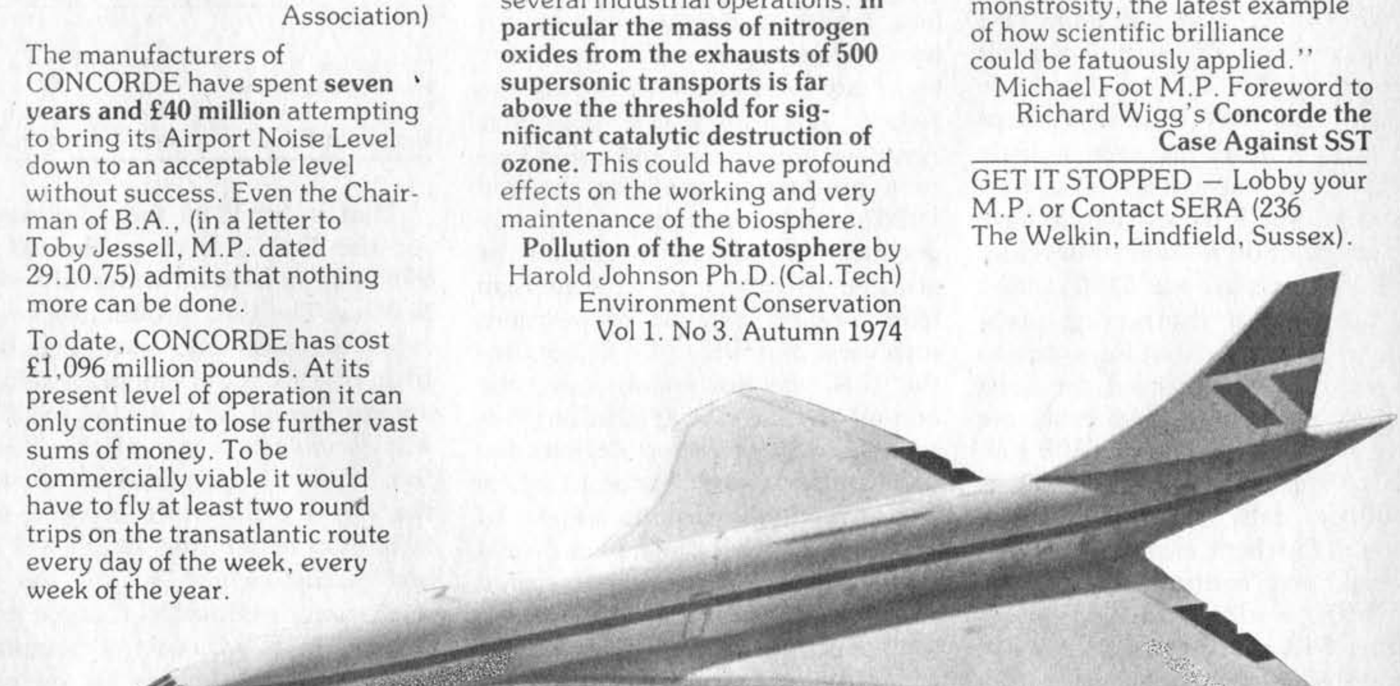
Report of President Ford's Council on Environmental Quality

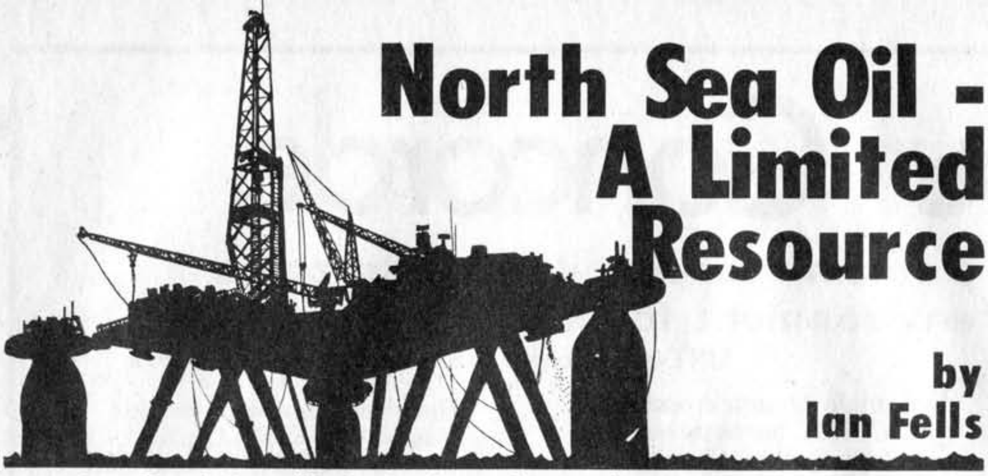
COMPENSATION amounting to £60.00 per mile per flight was paid for damage caused during Concorde's test flights. Disturbance, broken windows, flattened glass houses, stampeded farm livestock, a bolting pony and frightened people all bore witness to the damage done, and this at a time when the aircraft was carrying under half its capacity load.

"What little I did know about Concorde persuaded me that it was a prize technological monstrosity, the latest example of how scientific brilliance could be fatuously applied."

Michael Foot M.P. Foreword to Richard Wigg's **Concorde the Case Against SST**

GET IT STOPPED — Lobby your M.P. or Contact SERA (236 The Welkin, Lindfield, Sussex).





North Sea Oil - A Limited Resource

by **Ian Fells**

At last North Sea oil is beginning to flow from the Fortes field in the British sector and from the Ekofisk field in the Norwegian sector of one of the most inhospitable and dangerous offshore fields in the world. By 1980 despite delays and "slippage" between 100 and 140 million tons of oil a year should be coming from the U.K. sector of the North Sea; more than enough to make the U.K. self-sufficient in oil, provided our demands have not risen too rapidly between now and 1980. This is very good news as far as the economy is concerned but there is a danger that the country may come to believe that this indigenous oil will be the cure for all our economic ills.

How much oil is there out in the British sector? Between 2 and 3 per cent of the proved world reserves of oil, which will make us a producer about the size of Kuwait during the 1980's.

How long will it last? Perhaps twenty-five years or even a little longer. Is it expensive? Yes, very expensive; the Fortes field will have cost about £600 million to develop. The initial estimate was £360 million but unexpected engineering problems, inflation and hold-ups due to bad weather have caused the costs to rise. The Brent field costs are rising from an estimated £800 million to over £1500 million, that is £3000 per daily barrel of oil production. Further exploration and drilling costs continue to escalate but with world crude oil prices nearing $12 a barrel there are still substantial profits to be made, provided that world oil prices do not "slip-back".

What will the financial benefit be to the British economy? The U.K. balance of payments deficit due to imported oil in 1975 was £3,400 million. By 1979 we will have borrowed £12,000 million on the strength of our North Sea oil so that to be self-sufficient in oil by 1980 is enormously important as far as our credit worthiness in the world is concerned.

Are there any snags in the success story?

There are unfortunately a few. Taking finance first, the £12,000 million debit must be repaid. This means servicing the loan at the rate of at least £1000 million a year without taking into account repaying the capital. If this repayment is to be financed from our oil revenues as an oil exporting nation it means, assuming a realistic rate of interest and inflation, that we must sell abroad 1.4m barrels a day (according to Professor Holland's analysis) in addition to the 2 million barrels a day we require for home consumption. This is a very high rate of extraction during the 1980's, certainly higher than that currently anticipated and could lead to a production peak by the mid 1980's and thereafter a steady decline. Of course it should be possible to service part of the loan from non-oil balance of payment surpluses. But the 1974 figures for the U.K. are not encouraging; the non-oil deficit was £382m but this was made up of export deficits due to manufactured goods of £1,812m and an invisible earnings surplus of £1,430m which points to a dismal performance as far as manufactured exports are concerned.

From this analysis it is clearly necessary to expand North Sea oil production in the British sector and to extend exploration further afield. Unfortunately investment in the North Sea is slowing down as there is still considerable uncertainty about the exact role of the National Oil Corporation and just what "participation" will mean in terms of oil company profits. The rate at which petroleum revenue tax is to be levied is also unclear, particularly as far as small potentially less profitable (in company terms) fields are concerned. American companies and their investors are reluctant to commit more money to a venture where the rules have not been clearly laid down, even if they have been hinted at. The government is still walking the political tightrope stretched between party dogma and profit and loss but its role must be made crystal clear and realistic profits for oil companies guaranteed before investment in the North Sea accelerates again. And of course exploitation not only of the North Sea but also the Celtic Sea is essential if high production rates are to be maintained.

It is perhaps too easy to see North Sea oil purely in U.K. terms. The view from Brussels is very different where it is seen as an important part of E.E.C. indigenous fuel supplies. The two 1985 projects for E.E.C. fuel mix are shown below.

	1985 at 40% dependence on oil	1985 at 50% dependence on oil
Solid Fuel	17	17
Oil	41	49
Natural Gas	23	18
Hydro & Geothermal	3	3
Nuclear	16	13
100% in M.T.o.e.	1470	1470

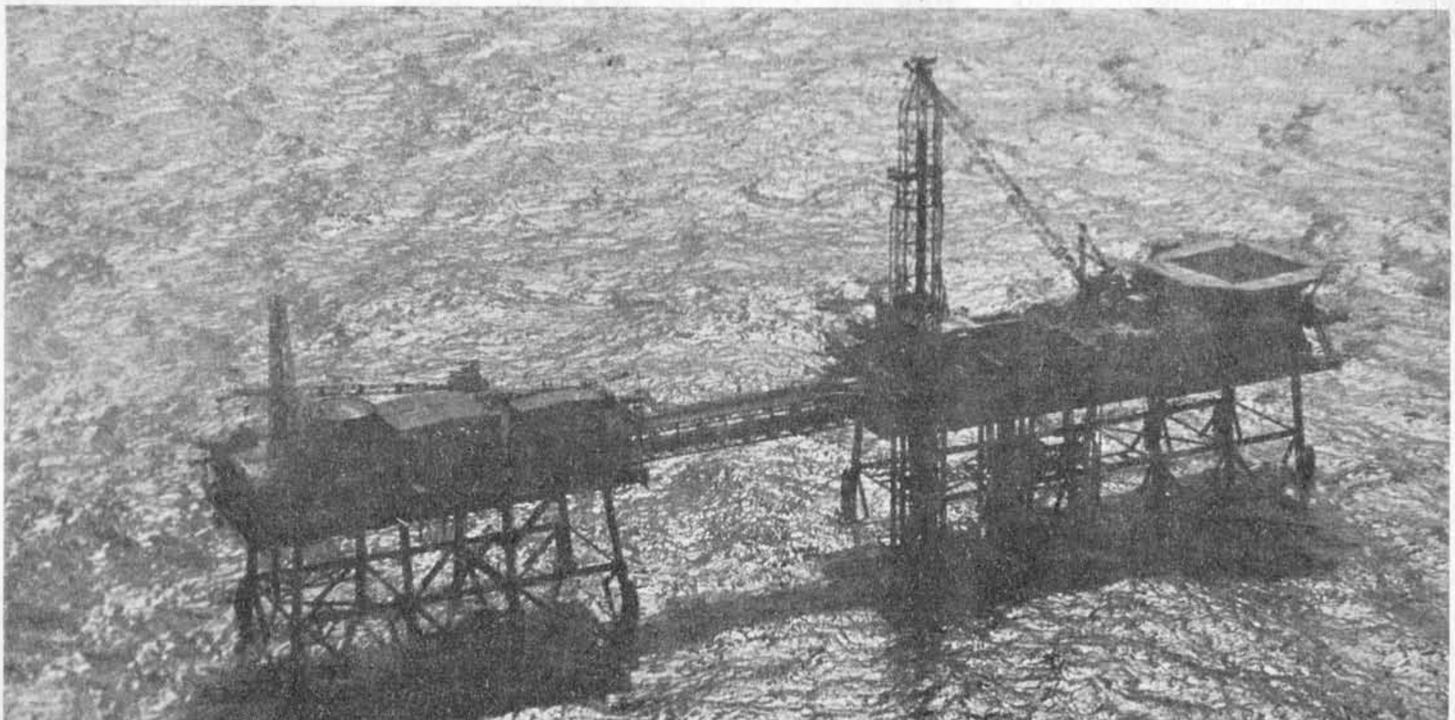
That is, by 1985 the oil element for the E.E.C. is to be limited to 650 M.T.o.e. and preferably 600 M.T.o.e. The U.K. production could meet between one sixth and one fifth of this requirement; a similar amount could be provided by Norway from her sector of the North Sea if she is prepared to exploit the oil at a high rate of recovery. It is easy to see that North Sea oil and particularly U.K. oil has an important, politically charged role to play in E.E.C. energy planning. The U.K. position as an oil producer in the 1980's is very different from the position of the other E.E.C. countries who will not have such a role, with the exception of Holland as a producer of natural gas. This all brings further pressure to bear on the U.K. to exploit North Sea oil as rapidly as possible and sell it in Europe.

But in a way this is the biggest snag of all. The oil can only provide a breathing space whilst we get our future energy policy and fuel mix right. To see it as anything but a stop-gap is naive, although politically it is unfortunately presented as a cure for all our ills. Another look at the E.E.C. plan for 1985 should convince us of the proper significance of oil and particularly indigenous North Sea oil. At forty per cent dependence on oil (1/6 from the North Sea) the nuclear fuel component of the E.E.C. plan requires 150 Gigawatts of new nuclear plant to be built by 1985. That is a hundred new nuclear power stations at a cost of about $120,000 million. It requires a modest expansion of the run down coal industry of the Community and a trebling of the natural gas supplies. But as oil supplies from the North Sea and elsewhere begin to decline post-1990 the nuclear industry and the coal industry must take a much larger share of the energy demand and this means planning now, and implementation of the plan in the very near future. We know that energy conservation techniques have been slow to be adopted and that the concept of low or zero growth in energy consumption is regarded as politically not only unacceptable but impossible. The delay times in implementing energy planning decisions are now beginning to be understood. It takes ten years to do almost anything, build a nuclear power station, get a new coal mine into full production, train the necessary manpower to build and run the energy industry.

It is essential to start planning now using the breathing space that oil can provide, so that a widespread, viable energy supply can be set up. It will be based on coal, nuclear energy, hydro and tidal power, possibly wave power and geothermal energy, certainly a much higher contribution from solar energy and ultimately fusion power but that is post 2000 A.D. By 1995 oil must be reserved for uses such as petrochemical manufacture, lubrication and probably air transport where serious alternatives are difficult to imagine. Unless the role of oil is seen in these terms, that is as an energy supply of very limited duration that can be used whilst we get our future supplies properly organised and financed, then having North Sea oil could prove more of a curse than a blessing.

The United Kingdom has perhaps the best fuel mix in Europe with a strong coal industry, an important gas industry supplying 15 per cent of our needs, an electricity supply industry largely coal based but with a strong nuclear component and, of course, a youthful oil industry. Alternative income energy sources such as tidal power, solar power and so on are largely neglected in serious research support terms. Even wave-power which is currently fashionable is being financed to the tune of less than £100,000 whilst research on nuclear power was supported by £70 million in 1974. This fuel mix is only satisfactory whilst oil is readily available and present difficulties with the nuclear programme suggest that it would be unwise to rely upon it to fill the energy gap left by a declining oil availability. For once the United Kingdom really does need a fuel policy and it needs it now if it is to be implemented in terms of finance, engineering and supply of trained manpower. It will take all the 25 years breathing space provided by North Sea oil to have an assured broad based energy supply sufficient for the needs of a heavily industrialised nation by 2000 A.D.

Photo: Barnaby's Picture Library



Shell Charlie against the sun

Earthquakes and Pre-fabs

by

Jon Cavanagh and Fiona Johnson

The Kurds are an ancient people claiming descent from the Medes. They consider themselves a single nation but have no country of their own. They are spread over six neighbouring states, stretching from Russia, through Iraq and Iran as far south as Lebanon. Originally nomadic people they have started to settle over the past few decades, but in most cases this has been for economic reasons. Their lifestyle however, still sets them apart from whichever country they have found themselves in.

At 12 noon local time on September 6th, the town of Lice, in Eastern Turkey, was destroyed by an earthquake. Although Lice is in Turkey, the people of the area are Kurds, belonging to one of the largest minority groups in the world. Because the earthquake happened on the eve of the Moslem Fast of Ramadan, the women and children were at home preparing the traditional feast. Most of the men were either out in the fields or praying in one of the mosques, consequently the death toll was almost exclusively female. The forces of the earthquake were not only felt in Lice although it was the most severely affected settlement. Six other small towns as well as many tiny villages in the vicinity were also damaged and they too suffered heavy death tolls.

Over three thousand people died and another two and a half thousand families were suddenly made homeless. In all 15,000 buildings were either totally destroyed or heavily damaged by the earthquake.

Once it was established that Turkish and International Relief had reached the victims quickly and efficiently, little more was heard of Lice. But the upheaval and grief did not end when the dead had been counted and buried. For those who survived, a second and more insidious assault was just beginning. The aftermath of the earthquake was to bring with it a serious threat to the culture and lifestyle of these people.

In the area of Lice the Kurdish people had carved out a separate existence on the slopes of the Tauros mountains. Here lived a tightly knit community nestled high on the mountainside. This small town with its maze of narrow streets was packed with buildings made mostly of mud. There were four tiny mosques, a 'hamami' or public bath, odd stores here and there and a scattering of official buildings. The sounds of chickens, ducks, dogs and cats together with the shouts of children contributed to the noise of the streets. In the hundreds of neat little houses the women passed the days busying themselves with domestic duties and looking after the children – who sometimes number as many as ten or twelve per family.

Generally the women did not stray far from their houses except perhaps to fill the jugs with cool mountain water at one of the fountains which were dotted about the town. The men worked in the fields just outside the town, looking after their herds of goats, or taking care of their small crops of tobacco, tea and vegetables. After work they could be found drinking tea in the little tea-houses (which form the centre of the town's social life for the men), or in the stores buying the few essentials their families needed. Smuggling was part of town life too, and the craggy mountainside provided

Photo: Jon. A. Cavanagh.

Ruins of Lice.

ample hiding places for contraband.

Turkey was only established as a Republic in 1923, and its international position stands somewhere between 'developed' and 'developing'. For a comparatively new territory like Turkey striving to achieve a national unity and identity, a somewhat autonomous Kurdish community, as Lice was, proves something of an embarrassment.

The earthquake which destroyed all this, ironically provided the Government with the unique and unexpected opportunity to make vast changes and bring some kind of national uniformity to the area.

The nationalistic Turks refer to the Kurdish people euphemistically as 'Mountain Turks'. They have already banned the teaching of the Kurdish language in schools, the publication of anything in Kurdish, and forbidden anyone to wear the Kurdish national costume. Furthermore over the last 10-15 years the Turkish Government has made various attempts to try and entice the people down from the mountain areas. A few years ago the government built some houses on the plains below Lice in an effort to get the people of the town to move. But the locals boycotted them and so the houses have remained unoccupied ever since.

The Government officials claimed that these houses would minimise the chances of major destruction and loss of life in the event of an earthquake. This may be true but they perhaps had other reasons. The feeling is that they were very keen to get the Kurds down from the mountains because it would be far easier to police and control them on the plains. The fact remains however, the local people *prefer* to live on the mountain slopes. They do not wish to be policed by a government they dislike and moreover distrust.

Turkey is particularly prone to earthquakes. It is situated on one of the world's major earthquake belts. Since 1940 well over 50,000 people have been killed and several hundreds of thousands of buildings demolished or severely damaged by earthquakes in Turkey. Since 1900 earthquakes have cost Turkey over £250 million.

The Turkish Government is extremely proud of the speed and efficiency with which it deals with disaster situations. The Ministry of Reconstruction and Resettlement, set up in 1965, is the co-ordinating point for the relief effort. The Ministry is so well organised that they have two large factories near Ankara which produce nothing but prefabricated housing – specifically for use after disasters.

In the case of Lice, relief was on hand within 20 hours of the earthquake happening, and within a few days all the survivors had a roof of some description over their heads. However the Men from the Ministry's involvement did not stop there. They embarked upon a massive re-building programme that included over 6,000 new modern houses, new roads where there had only been tracks before, new communication systems, a massive influx of labour from Ankara and Istanbul and mountains of forms to be signed in triplicate. In short, all the trappings of a totally alien way of life to the people of this remote and mountainous part of Turkey.

The re-building programme is now well under way. Plans for a new town of Lice, a mile away from the ruins of 'old Lice', were drawn up in a matter of ten days after the earthquake, and by November 10th, 1500 houses had been completed. In spite of their organisation, because of the scale of the earthquake, Turkey found that its own

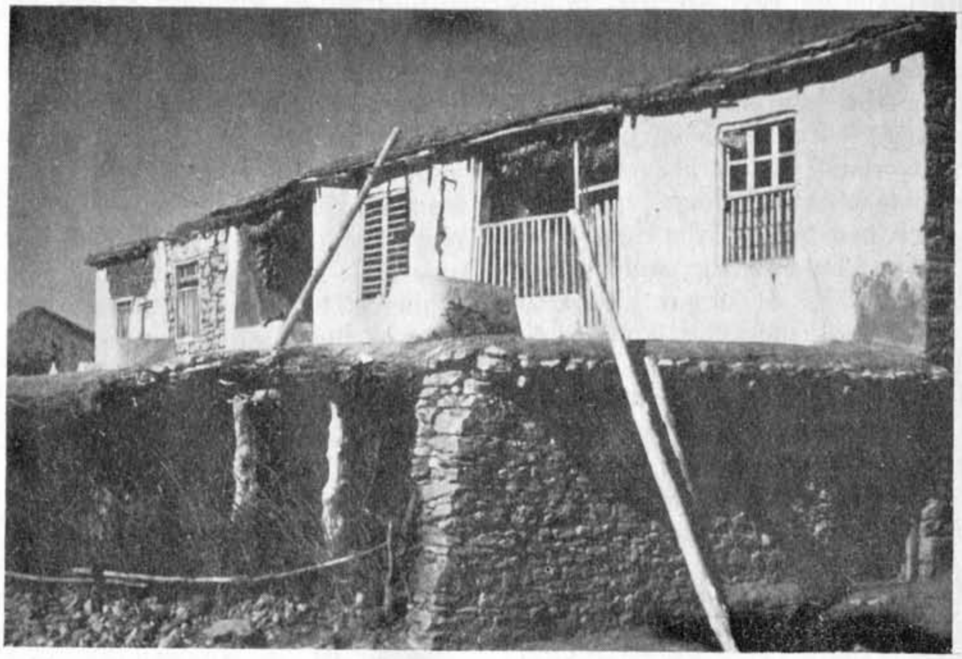


Photo: Jon A. Cavanagh.

Traditional Kurdish housing.

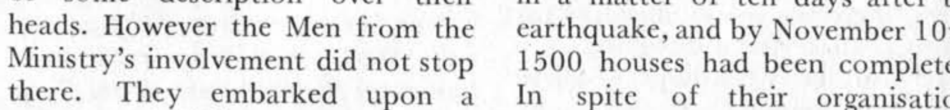


Photo: Jon A. Cavanagh.

Turkish Government housing.

stockpile of prefabricated houses was not large enough to provide all the new homes for their scheme, so other 'prefabs' have been brought in from Finland, Jugoslavia, Switzerland and France. They arrived in Lice on huge juggernauts which had been driven right across Europe. Despite the wide variety of countries of origin, all of the houses look the same. *None of the houses the Ministry has commissioned take into account the life-style and culture of the earthquake victims. They remind one of a cross between a building-site office and a holiday home which has strayed from its seaside resort.*

They are Western houses with the standard two bedrooms, a kitchenette, a living room and an inside toilet. The local people cannot relate to them. Even the large glass windows are clearly inappropriate in an area of extremes where temperatures can range from well below freezing point to over 100°F. There is also very little room for modification or the addition of personal touches. The Kurdish families are large and they need out-houses in which to store produce and keep some of their animals. The old town of Lice was exciting and full of variety, with its meandering streets and mish-mash of little stores and tea houses. In the new town, there are spaces allocated for shops, a space for the tea-houses, a space for the workshops – all so regulated, impersonal and uninspired. The old traditional housing of Lice, although not as earthquake-resistant as the new government housing, suited the local peoples' needs. After all, this type of housing had evolved as a direct reply to the specific needs of the families.

Nazim Be, the man in charge of the reconstruction in Lice said, "The old houses of Lice were primitive. The way the people kept their animals in and around their houses was unhygienic. The Government sees its duties as developing the society more and more and we want them to advance. We want them to keep their animals all together in a communal field away from their homes." Asked whether he thought the people would be happy in the new houses, which are completely alien to their culture and background, he replied, "I am one hundred per cent sure that the people will adapt quickly from their primitive houses to these modern ones."

But the local people think differently. They do not want to adapt. Why should they? They have had very little to do with the building of them. The Government imported most of the labour it required from other parts of Turkey. While they were being built most of the local men sat numbed and idle passing the days in the local tea houses. Only a few of the local traders busied themselves, by building small shanty homes and shops from the pieces of their old homes they had salvaged from the rubble.

They do not fear earthquakes. Their history is dominated by earthquakes which they believe are the will of God. The only real fear they have is to be caught homeless during the severe winter months.

Halil Akgun, the town's elected representative, said, "The prefabricated houses are all wrong. They are too small and the people will be very cold in them in our bad winters." He continued, "Unfortunately though, I think if it is a straight choice between a canvas tent and one of these things, they will be forced by their own predicament to move into them. *But when spring comes, I am sure many of the people will start rebuilding traditional homes on the mountain slopes.*"

Throughout their history the Kurds have shown great resistance and resilience to change and pressures. Some people think that an earthquake is not going to change all that. It will be interesting to see what does happen because Nazim Be is sure that the Government decision will be to forbid any future building of the old town. He said, "The old town will be bulldozed flat and nobody will live in old Lice ever again." Other people express the view that in a few years the new town will be a slum.

They took only twenty hours to reach Lice. When Nazim Be was asked what he had learnt from the earthquake he replied, "The next time an earthquake occurs we will be there even faster and build even quicker." Only time will tell whether the people of Lice will convince him that it is thought as well as speed that counts.

The developed world has all the technical knowledge, the resources, and the advantages of international communications at its fingertips. However the success of post-disaster reconstruction in places like Lice depends on more than bricks and mortar alone. In the race to bring relief to a disaster situation, governments and foreign agencies might benefit from stopping to consider the forces which hold together human communities. The need is not merely to provide homes, but homes of a *specific type* in which the survivors can continue to pursue their traditional way of life.

We have failed to appreciate that house design is an integral part of a cultural pattern and that to force people to live in houses which are designed to satisfy the needs of a different culture – in this case a very aberrant one, is to assure the disruption of their own culture and the disintegration of their community.

Notebook

Small is Happy

The findings published in February by the Department of Employment, showing that strikes increase in the direct proportion to the size of firms, will come as no surprise to most readers of this magazine. The actual figures show just how great the discrepancy is: days lost per 1,000 workers range from under 15 in firms with 11 to 24 employees, to over 2,000 in firms with 1,000 or more employees.

Predictably, spokesman for big industries were not slow in finding excuses, such as that some industries which *happen* to be big *happen* (for totally unrelated reasons) to have more strikes. Doubtless this is true in some instances: but the differences revealed by the statistics are far too great to be much affected by a few special cases. Another defence is that even two days per worker per annum, the highest figure, is not really a very great loss of working days. But this need not concern us here: the *Ecologist* and most of its readers probably regard strikes not as evil in themselves – in so far as they reduce the production of unnecessary or harmful goods they are surely a blessing – but as a symptom of an underlying evil. A strike is commonly the small visible part of an iceberg of boredom, frustration, alienation and discontent. What the Department of Employment's figures really reveal is that as firms get larger, workers get *unhappier.* We should not allow this lesson to be lost in a welter of arguments as to the economic, financial or technical desirability of large organizations. If economic efficiency and technical convenience are incompatible with human happiness at work, so much the worse for economic efficiency and technical convenience. The *means* must not be allowed to override and distort the *end.*

Last Refuge of a Failure?

The Top People's newspaper recently carried a particularly revealing full-page advertisement for a "Jaguar" (apparently a type of motor-car). The text, in those curious one-sentence paragraphs typical of the *genre,* was as follows:

"It will reassure you when you need it.

It will help restore your confidence should it ever desert you.

It will soothe and solace you after a hectic day.

It will insulate you from the noise and chaos of the outside world.

It will rebuild your morale, your ambitions.

But most of all, it will remind you that your life has not been totally without success."

Some of us have felt for years that one of the chief functions of car-ownership in our society is to act as a crutch for personalities crippled by the unnatural demands of modern civilization. It is pleasant to have this opinion confirmed from such an authoritative source!

Clean Water, Not Hot Air

The United Nations Environment Programme might sound to the cynical like just another international hot-air factory, producing pious resolutions by the waste-paper basket full without translating any of them into useful action. It is very pleasant to be able to report that, on its present showing, the three-year-old UNEP is the best thing to happen for a very long time in the field of environmental sanity. Its first major achievement was the agreement reached in February on reducing pollution in the Mediterranean.

The UNEP cannot be accused of picking an easy sea for their first effort. The Mediterranean is particularly vulnerable to pollution. It is very nearly land-locked, and despite the many large rivers which pour into it, water-loss through evaporation is so great that the main flow at the Straits of Gibraltar is *in* rather than out. It has been estimated that a total "turnover" of the waters takes about 80 years. As a result, the Mediterranean has become a giant stockpot simmering an ever more concentrated brew of noxious substances – raw sewage, oil spills, pesticide and fertilizer residues, heavy metals and other chemicals from factories, and wastes of all kinds. Already, some Mediterranean fish are unfit for human consumption due to their mercury content. Other fish, of course, are simply dying out: and without remedial action the sea seemed likely to be without marine life of any kind by the end of the century.

February's agreement is a triumph for the UNEP. It is remarkable both for the rapidity and lack of ballyhoo with which it has been brought about, and for the way in which traditional enemies like Greece and Turkey, Israel and the Arab states, have been persuaded to work together for the common good Only two Mediterranean states failed to attend, Algeria due to its current squabble with Morocco, and Albania locked in the self-imposed ghetto of its absurd ideology. But all sixteen other Mediterranean countries have adopted the convention.

The actual terms are a considerable advance on any previous international agreement to combat marine pollution. They include a protocol on dumping, listing substances which may not be dumped into the sea at all (such as mercury, cadmium, hydrocarbons and all radioactive wastes), and others whose dumping will require a special permit (such as pesticides and most metals). Another protocol lays down co-operative procedures for dealing with oil spillage, to be directed from a regional centre which will be set up in Malta.

As yet, the convention does not cover rivers and coastal outfalls: but a further protocol on these land-based sources of pollution is planned. And UNEP intends the entire operation as a test case, and plans to apply the lessons learned in the Mediterranean to other comprehensive regional schemes in the future – the Caribbean, Persian Gulf, Red Sea and Malacca Straits are among areas mentioned in this context. All in all, UNEP's Mediterranean Programme is the most encouraging move yet in the struggle to recreate seas fit for fish to live in.

Bottles Into Bricks

Martin Pawley, in his book *Garbage Housing,* tells a sad but instructive little fable for our time. It appears that in the Dutch West Indies many people live in corrugated iron huts, which are too hot when it's hot, too cold when it's cold, and liable to take off in high winds. The islands are littered with Heineken beer bottles, because it is uneconomic for the empties to be returned to the brewery in Holland. Someone had the ingenious idea of solving both problems simultaneously, by marketing Heineken beer in bottles with a square rather than round cross-section, so that when they were empty they would doube up as bricks.

The project proved perfectly feasible technically: and a prototype bottle-house was actually built in Mr. Heineken's garden. But a majority of the company's directors decided that they were not in business to house West Indians or to keep the Caribbean tidy, and the scheme was abandoned. So now Mr. Heineken is the only man in Holland with a summer-house made of beer-bottles: and in the Dutch West Indies many people continue to live in corrugated iron huts, which are too hot when it's hot, too cold when it's cold, and liable to take off in high winds . . . .

Red for Danger

"Tom Thumb set to work at once to carve the ham. It was a beautiful shiny yellow, streaked with red." (Beatrix Potter, *The Tale of Two Bad Mice.*) But "underneath the shiny paint", as all students of the Potter *oeuvre* will recall, that doll's-house ham "was made of nothing but plaster!" Synthetic, nutritionally worthless, garishly coloured – food of the sort which so infuriated Tom Thumb and Hunca Munca that they let fly at it with the tongs and the coal-shovel is now on sale in every supermarket. The colouring, presumably, is needed to conceal the effects of the manufacturing process from a public who might otherwise be reluctant to buy pale brown jam, grey tinned peas or transparent orange squash.

The dyeing of food for commercial purposes is not a purely 20th century practice; cheap sweets in the 1850s, for example, were found to contain red lead, arsenite of copper and numerous other poisons. What *is* alarming is that 120 years later poisonous dyes are still being used. The latest "permitted colour" to run into trouble is amaranth, the commonest red food dye in Britain and, until January, the U.S.A. (Since the correct name for this substance is trisodium 3-hydroxy-4- (4-sulphonaphth-l-ylazo)napthalene-2, 7-disulphonate, which was certainly never an ingredient in raspberry jam as Mother made it, it is understandable that the food manufacturers felt the need for something snappier; though their choice of 'amaranth', the name of the unfading flowers of Elysium in Greek mythology, is an unjustifiable prostitution of a beautiful word.)

Amaranth has been under suspicion for years. Since 1960 it has received only provisional approval in the U.S.A.; in 1970 it was banned by the U.S.S.R., and in January this year the United States finally followed suit. It is still permitted in the E.E.C., including Britain. Present arguments chiefly revolve round the experiments with rats which led to the U.S. decision. There is no doubt that they were conducted in an extremely inefficient manner, and that the results are scientifically suspect. But this hardly affects the wider issue. If amaranth could be permitted for 16 years and then, rightly or wrongly, come under suspicion as a carcinogen, can we ever be sure that any additive is really safe? Is it not time to treat chemicals in our foods as guilty until they are *proved* innocent?

A Wasted Asset

Dutch elm disease has left scars on our landscape which will take a generation to heal. But some good could come out of this evil, if the nation were to make use of the abundance of superb raw material represented by the 5,000,000 dead elm trees which are still standing. Elm is a first-rate timber for many purposes. There is unlikely to be much call for wooden water-pipes, wheel-hubs and lock-gates (three of elm's traditional uses): but coffins are in fairly steady demand! More to the point, elm is unequalled for chair-seats, floorboards and weatherboarding, being of all timbers the least liable to split and the most resistant to damp. In view of this, it is a pity that a sensible proposal from John Hancock, of the Association of Professional Foresters, seems to have fallen on deaf ears. He suggested that the Government should make a directive that whenever possible elm timber should be specified for all its contracts. If adopted, this scheme would save us the expenditure of millions of pounds for imported wood of inferior quality: and any elm found to be unsuitable for use as timber could be distributed to pensioners for use as fuel, as in a pioneer scheme run from the University of Essex. A small matter, perhaps, among the massive problems of our time: but it would be one step in the direction of that national self-sufficiency which even the experts are beginning to regard as a good thing to aim for.

Baby-Poisoning No Longer Recommended

Mammalian milk comes in a great variety of different mixtures, developed during millions of years of evolution to meet the special requirements of the young of each species. This being so, the news that cow's milk is on the whole less suitable for human infants than human milk hardly comes as a dazzling revelation. To be fair, the recent announcement from the Department of Health and Social Security went rather further than that. Up till now, baby milks (other than the home-made variety) have been of two types – one which is simply dried cow's milk with added vitamins, and one which, though based on cow's milk, has been modified so that its chemical formula corresponds as closely as possible with that of human milk. The DHSS now no longer recommend milk of the first type for babies under six months old, as it has been proved to be associated with a number of risks to the health and, indeed, the lives of young infants.

Even the modified milks, however, will always be second best. The DHSS had already recommended in 1974 "that all mothers be encouraged to breast feed their babies for a minimum of two weeks and preferably for four to six months". In practice, busy hospital staff are seldom able or willing to assist a process which, however natural, does not *come* naturally to most modern Western women. Far more than just pious recommendations will be needed to counteract the present social and cultural pressures against breast-feeding. In the present economic climate, an advertising campaign based on the slogan "It's cheaper by breast" might work wonders!

Remember the Tasmanians

Amid the commemorative junketings to celebrate the American colonists' successful U.D.I., the world is unlikely to remember a centenary of almost equal significance for humanity. On the 8th May 1876, an old woman died in Hobart, Tasmania: her name was Truganini, and she was the last survivor of the native Tasmanians. Many of her compatriots had been hunted down and shot as vermin; others, deprived of their tribal lands, died from malnutrition or apathy in squalid reservations; others fell victim to European diseases such as pneumonia and influenza. A fairly typical instance, in fact, of what happens to a primitive people suddenly exposed to the influences of modern civilization. As in most such cases, misguided kindness proved as fatal as brutality: you can kill a man as effectively by giving him a shirt to wear without telling him to take it off when it gets wet, as by putting a bullet in his head. The only safeguard for the surviving primitive peoples of the world would be total isolation. No prizes are offered for estimating their chances of getting it.

Nicholas Gould.

Books

The Energy Syndrome

THE TITANIC EFFECT by Kenneth E. Watt. Published by Sinauer Associates Inc. Stansford Conn. U.S.A. 1974. £2.20.

This is a very important book for those interested in the future of our industrial society. It is not written by an economist, as some people would expect, but by a highly respected ecologist, who is best known for his application of the Systems method of ecology. Watt points out that conventional economic wisdom cannot deal with the problems our economy at present faces. For instance, according to all accepted economic criteria, the economy was in a perfect state of health in December, 1972, just before a terrible crash. Clearly the criteria must be wrong.

According to Watt, the reason Modern Economics are so unsatisfactory is that they do not take into account social and ecological factors – which is what he attempts to do. "The thesis of this book," he writes "Is that all the symptoms, good and bad, together constitute a syndrome pointing to a single acute economic ailment: excessive, unplanned, undirected and destructive growth. By this, I mean the concurrent growth in population, economic activity, the per capita use of energy and other resources, plus the resultant growth in pollution and the effects of pollution on the environment and on human health."

From the economic point of view, the principal symptom of this syndrome is a massive rise in the cost of keeping the economy functioning.

Thus, the depletion of oil stocks is causing the U.S. to depend more and more on imported fuels.

How can America pay for them? The answer is by exporting food. Assuming realistic changes in the relative values of fuel and food, however, this is not likely to be possible for more than another five years or so.

He is particularly interesting on the environmental cost of air pollution. In order to calculate this, he takes four Californian counties, two of which, Santa Barbara and San Luis Obispo, are relatively air-pollution free, and two others, Riverside and San Bernardino, which are close to Los Angeles, and hence highly polluted. A comparison of the death rates in these areas is particularly illuminating.

The incidence of respiratory diseases is two to five times less in the non-polluted areas than the polluted ones. In general, it would appear that clearing the air pollution would reduce the death rate by 38 per cent. Further material from both the U.S. and the U.K., according to Watt, suggests that this is an underestimate, and that 50 per cent would be more realistic. He concludes that, "almost any expenditure to control air pollution in big cities would be justified."

His chapter on unemployment is equally valuable. He shows that during a period of unrivalled affluence and economic growth, the civilian labour force increased by only 1.26 million each year. Even if we keep up this rate, which is extremely unlikely, the economy would not be absorbing anything like the number of people entering the labour market, which will be increasing every year until 1977, on the basis of the increased birth rate of the last few decades, and which is likely to remain at this level until 1985. The fact that women are entering employment in greater numbers, that less people are likely to stay on at universities for post graduate degrees, and that the Vietnam War is over, can only make matters worse. Even more important is the increased 'efficiency' of industry and, as a result, the reduced efficiency of capital to generate jobs.

This must lead to increasing unemployment. He also shows, for instance that in the oil and gas industry, between 1950 and 1960, the work force declined in spite of the fact that production almost doubled. In agriculture, while farm production has increased by 41 per cent, 5.3 million workers – more than half the total work force – have lost their jobs. If the Government were to try to solve the inevitable unemployment problem, by increasing expenditure so as to provide jobs for an extra million people, since the average price of a job is now 7,400 dollars, "the federal budget would have to be increased by 7.4 billion." If one took into account associated costs, like extra office space etc., it would come to about 14 billion.

Watt goes on to examine the cost to the U.S. Government of selected expenditure which must be undertaken in the next twenty-five years, if the U.S. economy is to survive. This includes the cost of putting up the necessary power stations to provide the U.S. with the energy it will require, the cost of installing mass transit systems, of installing water and air-pollution controls and of urban renewal, to prevent the complete breakdown of America's cities.

The total is likely to be about 52 billion dollars per year, or almost half the investment by all U.S. industry in new plant and equipment in 1972. To this must be added a whole lot of other major expenses that have not been important hitherto, a tremendous increase in the number of railroad cars for shipping grain and fuel; an enormous investment in hospitals and the training of physicians to deal with an ageing population; research on methods of generating energy, as well as on innovations in housing. Can America meet the bill? He thinks it can, but only just, with the proviso that too much money is not wasted on other things: but it is clearly marginal. My feeling is that he has only touched on the subject. There are all sorts of other massive costs which can only escalate in the next twenty years, and which will become increasingly difficult to meet, even in the U.S. If one projects the probable rise in expenditure of Health and Welfare Agency (H.E.W.), the figures are truly terrifying.

According to *U.S. News and World Report* (21st April, 1975), they are expected to increase from about 11 billion dollars in 1974, to 500 billion by 1985, which represents half the total Gross National Product of the U,S. today.

What is the answer? Like all serious people today, Watt advocates a reduction in the size of things, i.e. political and economic decentralisation. This, would appear to be the only way to reduce costs.

Particularly eloquent, on this matter, is his calculation of the costs of Education, Public Welfare, Police, Fire, Highways and direct general expenditures in towns of less than 10,000 inhabitants, 25,000 inhabitants etc., all the way through to a city such as New York with 7.9 million inhabitants.

The most dramatic figures are those for Public Welfare. 12 dollars per capita, in the former case, and 192 dollars in the latter. Significant too, is the cost of police protection which rises from 5.70 dollars to 52 dollars.

I sincerely hope that this book obtains the wide readership it deserves, especially among our politicians and economists, who still seem to be living in a world of their own.

Edward Goldsmith.

Action Programme for Tomorrow

INVENTING TOMORROW: How to Live in a Changing World. Michael Allaby. Hodder & Stoughton £4.95. 245pp.

The title, *Inventing Tomorrow,* has been carefully chosen. It would have appealed to Ortega y Gasset who, in *Man the Technician* wrote that the mission of technology is to release man for being himself. Man creates for himself a programme of life: the practical aspect calls for an engineer; but technocracy cannot provide the wish and the ideals. The engineer must serve the philospher in man.

Michael Allaby tackles this theme of inventing tomorrow on both its dimensions, the technological and the inspirational. Two things determine the direction of technology: that which is physically possible and that which the contemporary outlook considers the desirable life. On both these dimensions we are living in a period of great change. When the laws of thermodynamics proved that a perpetual motion machine could never be invented, the invention of machines actually improved, even though many inventors were plunged into gloom by the discovery of the restraints placed upon them. Yet the constraints have turned out to be a source of hope, not of despair. It was realised that the conditions of invention were not so narrow that there could be only one kind of machine; they found within the new confines a wide scope for invention. And so it will be with inventing society when men realise that perpetual growth is as impossible as perpetual motion. It will be a stimulating challenge.

This is the major point that Michael Allaby has seized upon, and surely the most important for today. Properly appreciated many of those discoveries that have been interpreted as signing the death warrant of society should be a source of hope, the means of creating a better society. That is why so many critics of eco-doom cannot understand why the prophets of doom are so cheerful about it. To accept the challenge we must look realistically at the facts of our natural resources in relation to our aims to see what change in our way of life may be necessary. If we find the changes impossible to accept, may this not be because we have never considered any alternative outlook except that of our Western civilization or maybe even our own political party? Is our way the only way to fulfillment. Can we have such a monopoly of truth? What about Buddhism for example? Michael Allaby explores these questions.

To undertake a survey of the world, materially and spiritually, for the purpose of finding ideas and materials that will help us improvise a better future, is itself a daunting task: and one that Michael Allaby has brought off with exceptional skill and lucidity. He stretches the mind as we strive to keep pace with him and relate together all the information and judgements in so many fields that he has judiciously selected. In an enterprise of this kind it is very difficult to know where to stop; it is sometimes better to sacrifice 'facts' in order to keep the aim and motive more clearly in view. I don't know if this is a criticism one can make of this book, but I would warn the reader to recall to mind why he is being given specific information and not to lose sight of the thread that binds the book together. He will then better realise what a feat of comprehensive perspective – I can think of no better phrase – Allaby has achieved.

It is harder to describe the flow of a complex process than to draw up a blueprint. The flow of a complex process like that of the changes in a society is not a single vision. It has to take into account forces moving in several directions at once. The word blueprint is as unsuitable for describing any ecological plan as 'think-tank' is to describe the kind of people most likely to invent a creative tomorrow. It suggests a finished process that is carried out step by step in an undeviating manner; so it threatens authoritarian rule. The use of the term in 'Blueprint for Survival' was metaphorical it served as an eye catching title. But the team that produced the book, one of whom was Mike Allaby, would not use that word again. They recognise that there is no blueprint for tomorrow; tomorrow must be improvised, but nevertheless, by ignoring natural laws and principles, we could destroy ourselves. Allaby argues that the more we absorb into our imaginations the alternatives open to us, the less likely we are to make mistakes. And however much a utopia may appeal to us, such as the anarchist utopia of small self-governing communities, we have to face the fact that we must start to move in that direction from where we are now – with large cities of over a million inhabitants and an individualist not a tribal culture. We must recognise that what suits one region of the world doesn't suit another; that we may have several different patterns of civilization and culture, partly the result of past traditions, partly in the region of unequal distribution of natural wealth and partly the result of prevailing economic systems.

Such a broad survey of all the complex factors involved in inventing tomorrow diminishes fanaticism and ideological rigidities without diminishing enthusiasm or quenching hope. We must not think the apparently unreconcilable is necessarily so if seen from new perspectives; for example, regional government fits better into a continental system than national government, though the regional and the international aims would seem to be contradictory. When we have to reduce the amount spent on education by a degree of deschooling we find ourselves better educated as a result of substituting apprenticeship; when we reduce the amount spent on the Health Service by cutting down on drugs, medicines and the most advanced medical machinery, we find ourselves in better health by paying more attention to what we eat and drink and the health of the environment; when we can no longer spend hundreds of millions on fertilizers and biocides, we find that we farm better and produce more by concentrating on market gardening and growing our own food . . .and so on. Michael Allaby devotes a section of his book to exploring what has been written and said on these possibilities. I find that a mere list of the possibilities of change resulting from adapting to adversity is exciting and inspiring. Isn't it better to use our human ingenuity to search out healthier ways to prosperity than just to continue in the same old materialistic competitive spirit serving gallons of champagne on the Concorde to make the passengers forget the thousands of gallons of fuel they are wasting? Mike Allaby thinks so and it kept him at his daunting task in a year when he travelled over thirty thousand miles himself! A great achievement.

Robert Waller

Neolithic Revolutionaries

FARMING IN PREHISTORY, From Hunter-Gatherer to Food-Producer by Barbara Bender. John Baker. £5.50.

In recent years interest in the origins of agriculture has been stimulated by our own problems in trying to feed an expanding population from a narrowing genetic base. It is very possible that in years to come we will need to widen the range of plant and animal species on which we depend for food. As *The Ecologist* has argued many times, we might do worse than look at the foods our ancestors ate, try to discover why they domesticated the species they did and see whether other items in their diets might be suitable candidates for our own future cultivation or husbandry.

In fact, though, the "neolithic revolution" is shrouded in mystery. Theories abound, often based on the flimsiest evidence. Many people have assumed, for example, that it was some kind of environmental change, resulting perhaps from the end of the Pleistocene glaciation, that triggered the beginning of agriculture some ten to twelve thousand years ago. Yet, so far as is known, agriculture began in regions that would have been little affected by such changes. We have assumed that it was the development of settled agriculture that made it possible to build cities, but one worker at least, Jane Jacobs, suggests it may have happened the other way round. The growth in trading led to the development of large settlements sited strategically on trade routes and their inhabitants subsisted by hunting and gathering until they managed to domesticate favoured food species. Ms Jacobs is an economist rather than an archaeologist and her thesis is largely untested, but it is less outrageous than it may seem. At es-Sultan (Jericho), ten thousand years ago, there was a city of two to three thousand people who lived in substantial buildings, defended by large fortifications, but who made no pottery and who ate wild foods. Were they traders? Trade certainly played an important part in the development a little later of Catal Huyuk, in Anatolia.

The archaeological evidence is sparse, partly because it is only in modern times that archaeologists have searched for it, but mainly because plant remains have been preserved only in particular environments. So we may believe agriculture began where traces of it have been found, but is that only because in other sites those traces have been obliterated? All that does seem certain is that at different times and in different places different species were domesticated, that agriculture began independently in many cultures.

At this point the student may feel the need for a guide through the labyrinth of evidence, theories, papers and books. Barbara Bender is just that. She claims no originality for her book, but she is too modest. True, she does not describe the results of her own excavations, but what she does is more valuable. She draws together all the strands, compares theories, points out where views diverge or converge, and evaluates the work of others. Her rummaging through the literature is dauntingly thorough: her bibliography occupies sixteen pages of small print.

Dr. Bender begins by examining the significance of the transition from hunting and gathering to food production in terms of social development, the emergence of crafts, and the effects on, for example, the carrying capacity of the land. She considers the various theoretical models that have been constructed to explain the transition and the difficulties encountered in trying to determine the point at which a species may be considered to have been domesticated. Since climatic change has been postulated in a number of the models, she devotes a chapter to climate changes that are known to have occurred and follows it with a chapter on the distribution of potential domesticates. Finally she moves on to discuss in detail the beginning of food production in South West Asia and in Meso-America and Peru, the regions that at present offer the most complete archaeological record. Other regions are treated more briefly in appendixes.

Farming in Prehistory is a serious study of the work that has been done in the field and by drawing together information from a wide variety of sources it makes a substantial contribution to or understanding of the subject, while at the same time identifying clearly those areas where information is lacking. It is an essential tool for anyone seeking to learn more of the early origins of civilisations. I cannot recommend it too highly.

Michael Allaby

Limits to Ameliorism

LIVING IN CITIES by Charles Mercer, Pelican, 75p. WHOSE CITY? by R. E. Pahl, Penguin, £1.25.

The first of these two books claims to be about environmental psychology, or the relationship of man to his self-created physical environment. Mr. Mercer is disturbed by the disdain many people now express for modern city life; for he presumes that the continued long term existence of cities is inevitable, but he fails to ask any pertinent questions about the provision of resources, increased cost and ineffectiveness of services, rising social disharmonies etc., and about the underlying problem of which these are merely symptoms. Instead he makes an act of faith in the adaptability of man and the ability of experts to plan for a better future. Experts will be able to do this he says, using their new understanding of environmental psychology which will provide '. . . some scientifically derived and reliable information about what man is doing to himself . . .'

It is worth noting a few of his arguments in favour of living in modern cities. On the crucial question of size he simply says that a bigger city can offer more variety and interest, and it is in the nature of man to seek these things. Next he asks if the 'build-use-demolish' cycle is necessarily bad, for if human needs change then so must buildings. He then glibly states; 'Surely it is not coincidence that the few "primitive tribes" of the world have finished up in psycho-social evolutionary dead-ends and use building forms that remain unchanged throughout human history.' And as if this is not sufficient nonsense for one page he goes on to say that increased mobility '. . . far from imparting rootlessness or anomy, could be considered as a continuing reinforcement to man's adaptability.' It is upon naive assumptions like these that the rest of the book is based. I am no expert in environmental psychology but I do happen to know that man was never meant to live in vast cities, as a result we have to pay the price by making a series of maladjustments and replacing social needs with material needs. It now seems we have reached such a state of imbalance that many people will find it necessary to take this misguided book seriously.

Whose City? is a collection of essays by Professor Pahl; some old and revised others are only recently published. They concern the way the public are demanding a greater say in planning and the subsequent problems of conflicts of interest. Much of the book appeared to be rather lacking in direction and devoid of any conclusions, perhaps because one can easily get lost among the mass of detailed reporting of case studies. However Prof. Pahl redeems himself in one of his more recent essays by deciding that there are no solutions to the problems of the city – apart from ameliorism. "As long as there are modern big cities there will be a need for ameliorism.' But unfortunately he never considers what will happen when ameliorism reaches its limits, in fact he never establishes that there are limits. Once again this is a typical example of an expert failing to take into account all the relevant information. However, I must moderate this prejudiced harangue as I am well aware that as ecologists we are often at a loss for ideas when confronted with the reality of cities. The only enlightening article I have seen is Robert Allen's account of Phnom Penh. (*Ecologist July 1975*) just how do we propose to decentralise Greater London? Surely not by planning-or is it deplanning? For, as Illich says, management of the crisis would make catastrophe irreversible. There is much thought required on how cities are to be dismantled as ameliorism reaches its limits. Unfortunately these two books add little to the debate.

Peter Stables

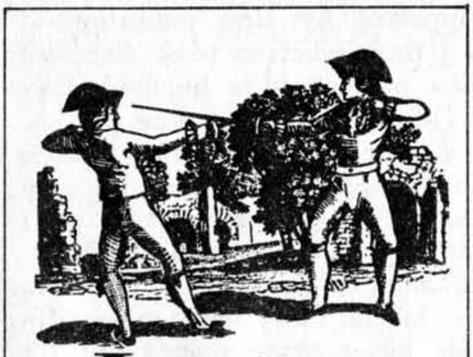
This Month's Authors

Ian Fells (M.A., Ph.D., F.R.I.C.) is Professor of Energy Conversion at the University of Newcastle upon Tyne, Department of Chemical Engineering.

John Cavanagh is at present researching into Disaster Housing at the University of Newcastle upon Tyne. He has travelled widely in South and Central America, Africa, Europe and Eurasia. He and **Fiona Johnson,** who is a freelance reporter/broadcaster at the B.B.C., have recently returned from Turkey, where they have spent some time observing the relief operations and rebuilding of Lice.

Erik P. Eckholm is a researcher with the Worldwatch Institute in Washington D.C., and author of *Losing Ground: Environmental Stress and World Food Prospects* (W. W. Norton and Co., N.Y. 1976) and co-author with Lester R. Brown of *By Bread Alone* (Praeger, N.Y. 1974).

Peter Bunyard read Biology at Cambridge and was a post-graduate student at Yale. He later became for a time Science Editor of *World Medicine* and was one of the original founders of *The Ecologist,* the author of the leading article in the October 1970 issue "The Power Crisis". He moved to Cornwall nearly four years ago and since then has devoted much of his time to his 17-acre farm, which is run ecologically without chemicals or machines.



Letters

Action not Perfection Needed

Dear Editor,

I want to say what profound satisfaction it gives me to see the similarity of Gandhiji's thought and the ecological truths so clearly expounded in *The Ecologist's* special India issue: Vol. 5. No. 8. In this union of spiritual and scientific wisdom most surely lies the seed of a great Movement. But let us avoid the name of Gandhiism. Gandhiji himself said in so many words: "There is no such thing as Gandhiism". True, at that time Gandhiji was thinking of a Sect, whereas *The Ecologist* is thinking of a Movement, but there is little difference except in size. Whether it be a Sect or a Movement, if it is formed round one particular person, it quickly develops its own rigid theories and fanaticism (especially when that person had a certain fanatical streak in his nature, which others could catch hold of and exaggerate afterwards).

Gandhiji was all the time feeling his way, experimenting, searching. I heard him remark once, in conversation, that many more Gandhis would have to come before the full meaning of non-violence could be demonstrated. I think it was this feeling that made him so averse to putting his ideas into a fixed form. He felt that those who would follow him should continue the search, not sit down and crystallize his thought at the point where he left it.

Adi H. Doctor has emphasized Gandhiji's use of the "Euclid's straight-line" method of arguing, and his article is full of interest. Personally I found Gandhiji's 'Perfection' kind of talk least inspiring, and perhaps it has been responsible for much of the haziness which has followed after his departure from our midst. When one tries to sense why the goal of 'Perfection' is not inspiring, I think one finds that it is because of 'Perfection' being humanly impossible, and, because, if it could be attained, it would be a state of deadly monotony – a kind of dead-end. And is that not because the human conception of 'Perfection' is faulty? Nature's 'Perfection' is different and far from monotonous.

Gandhiji was essentially a fighter, a man of action, there was nothing of non-resistance (so often mistaken for non-violence) about him. And his unique insight regarding non-violence enabled him to use it in all directions – social, political and economic. His realization of the ecological truths came to him through his understanding of non-violence, just as did his conception of self-sufficient, self governing, village communities. And every activity of his daily life was guided by the determination to put into practice as far as possible the truths that came to him.

Whatever the name of a Gandhi-ecological-movement may turn out to be, its watchword should be 'Action'!

Here is a personal experience I went through with Gandhiji regarding that 'Perfection' difficulty. He used to tell me 'I want you to be a perfect woman', and he also used to say to me 'You must be yourself, otherwise you cannot grow'. Well – it just did not work, and what is more, the ideal of a 'perfect woman' roused no enthusiasm in me but, on the contrary, sent a chill through my being. I did not argue it out to myself this way or that – the fact was just there.

Regarding the articles in Part 1, Doctor Swaminathan's is of course, a masterpiece of information and B. B. Vohra has so many excellent suggestions, but he is not in a position to mention the fact that the deep seated corruption of the bureaucracy undermines all efforts by honest people to benefit the rural masses through Government channels.

J. C. Kapur's sweeping diagnosis of India's ills is excellent and so is the general objective of the cures he puts forward. What troubles me in reading his article is the faith he puts in statistics. The computer has made calculating so easy that people are tempted to draw their own conclusions more and more from statistics rather than common sense based on study of facts on the spot. In the case of India, statistics are most unreliable and in the registration of births and deaths I have no faith at all.

You will notice that in Kapur's scheme the Gobar Gas Plant (Biogas Plant) plays so important a part that without it the whole structure would fall to pieces. I have had no personal experience of the Gobar Gas Plant, but from what I have read and heard about it, I do not believe it to be the wonder solution for India's countless little villages that it is claimed to be.

I can understand the Biogas Plant being excellent for cities and communities like agricultural and animal-husbandry centres, but not for small villages. In big villages with well-to-do farmers it might also be taken up, but from what I have heard, villagers on the whole do not take easily to the Gobar Gas Plant. It is for them complicated and it easily gets out of order. In any case to tie the preparation of organic fertilizers to Gobar Gas Plants would hopelessly limit its production. The crying need for India is well prepared compost (like in China), which can be made in every little village without any cost or dependence on others. Another thing which concerns me about the Gobar Gas Plant is the danger of fire. Village cooking is done on the floor, and to have open gas flames where children and animals are running around and where there are no closed windows (because there is no glass) is to ask for trouble. A gas flame is very different to that of wood or coal – I would hate to put gas into the hands of unsophisticated villagers.

It is surprising that Kapur has paid so little attention to trees. Besides the need for trees in the catchment areas of the rivers for checking floods and erosion, the villages of the plains should grow trees in every nook and corner and along the sides of roads and canals.

They would check the winds, soften the climate and, at the same time, provide wood for fuel, building and farming needs. It is of course, a long-term programme, but is absolutely essential for the recovery of India.

The standard of life suggested by Kapur for a rural community of 1000 might be attainable for sophisticated villages near cities, but quite unthinkable (and unnecessary) for the tiny hamlets dotted far and wide over India. It was amongst those sorts of villages that I lived and worked, and it is they who are the foundation of the nation. If Kapur, with his excellent understanding of India's ills, could bring himself to accept a simpler standard, then one might begin to dream of his scheme as possible, but in any case, between its achievement and present conditions, some kind of fundamental upheaval is bound to come. The thing is to be ready with right ideas and as many functioning demonstrations of these ideas as it is possible, even partially, to create during the difficult period between now and then. Of course Sarvodaya and Gramdan are already there, and doing most worthy work, but there is need also for something broader based and less timid.

Yours sincerely,
Mirabehn,
Austria.

(Mirabehn is the name given by Gandhi to an English woman who was a beloved friend of his and one of the most distinguished of his surviving disciples.)

Party Politics?

Dear Sir,

The National Secretary of the Ecology Party makes some perceptive and justifiably critical points vis-a-vis the Liberal Party and its attitude to the ecological movement, but as one who took the lead in the no-growth debate at the 1974 Assembly, I think he is less than fair to a large and growing body of Liberals.

True, the Liberal Party is still committed to growth, but at least, alone amongst the Parliamentary Parties it has extensively debated the issue and has been willing to make some policy moves in the no-growth direction. Perhaps it is significant that the Liberal Party refused to take part in the obscene celebrations to launch Concorde.

But I do not want to act as an apologist. I too am dissatisfied with the Liberal Party stance. Where I differ from Mr. Lord is that I believe in the tradition of freedom in the Party and accumulating evidence from its members suggests that it can be converted to a coherent no-growth philosophy. If I did not believe that I would join the Ecology Party.

Let me indicate, though, some of the advantages of working through an established Party, at the same time pointing out some of the real difficulties facing a practical politician in phasing policies to a no-growth direction.

The Liberal Party does provide substantial experience of strategy and tactics, of policy information and of communication which can be turned to advantage to promote new policies. So, you might say, do the other 'traditional' Parties. There is a significant difference in the Liberal tradition of radical and open thinking and, for many of us at least, a concern with right principles and eventual leadership rather than an obsession with immediate power. Those, I believe, are genuine reasons for the Liberal Party playing a part with, and not in conflict to, the Ecology Party.

But there are real difficulties for the practical politician wishing to be honest and responsible. Peter Hall, a number of years ago produced a Manifesto which came as close as I know to spelling out the extended time scale for sensitive and non-disastrous conversion to no-growth. To persuade the public of that time scale; to phase it through complex policy decisions and to effect it, faced with immediate, chronic, materialistic pressures is an enormous task and one which has tried my intellect and conscience as a councillor and as a parliamentary candidate on three occasions.

What I am trying to say is that the task is not easy and should not be made to seem so by facile statements of beliefs (which I share) unsupported by clear indication of how these beliefs are to be converted into practice in a hundred daily decisions for millions of people.

I hope the impression I leave is not one of unfriendliness. My only challenge is to method not end. I simply would not want my determination to achieve that end in the Liberal Party made more difficult by it being singled out for particular criticism.

Yours faithfully,
Councillor Eric Robinson,
South Shropshire Liberal Party,
Bridgnorth.

National Income Scheme

Dear Sir,

Your correspondent S. H. Allen, of Malvern, Australia (Ecologist, January 1976) will be pleased to learn that the Ecology Party Manifesto already includes precisely the social welfare system he proposes. Indeed, it is quite surprising how well a National Income scheme dovetails with ecological imperatives when the ramifications of each are explored.

It is unfortunate therefore that to many conservationists, the idea of guaranteed subsistence is at best irrelevant, or at worst inimical to our aims. The removal of insecurity does not guarantee ecological behaviour, but it is an inescapable precondition. Anyone who doubts this should pause to consider which they would (will?) choose if faced with the threat of disaster later – or starvation now.

Yours faithfully,
Clive R. Lord,
National Secretary,
The Ecology Party,
W. Yorks.

How Valuable are Nature Reserves?

Dear Sir,

A life-long naturalist, I have for very many years been a student of ecology, that is the inter-relationships of living plants and animals, including man, with each other and with their non-living environment. These studies led long ago to a realisation of the inherent evils of industrialism: pollution, exhaustion of scarce resources, and a general degradation of human life and work. So much seemed obvious to me fifty years ago, and the dangers of the human population explosion were apparent even when the world contained only half as many people as now. For long I felt alone in my concern, a voice crying in the wilderness, but the recent growth of interest in such matters, evidenced by articles in *The Ecologist* and in many other ways, is most encouraging to an old campaigner. Knowing something of scientific ecology, I was intrigued by the choice of title for your periodical and hoped it signified a sound basis for your spirited attack on the plague of people and the curse of industrialism from which the world is suffering.

I have been taking *The Ecologist* for two years now and I would say in general that it lives up to its title. I was, therefore astounded to read the editorial "The Two Ecologies" in the December 1975 issue. The sheer rubbish on page 365 gives the unfortunate impression that Edward Goldsmith has read very little about the biological sciences in general and ecology in particular. Surely he knows something of the work and writings of great plant ecologists like Godwin, Salisbury, Tansley, and many others. Tansley's *The British Islands and their Vegetation* (Cambridge 1939), for example, takes a broad view of ecology and gives sound background knowledge for anyone interested in preserving our environment. Rackham's *Hayley Wood, its History and Ecology* (Cambridge 1975) is quite up to date and a very readable account of the social and natural history of an essential element in the English countryside, now and for the past seven hundred years. By reading about and taking part in such careful and painstaking investigations we can learn from the past and plan hopefully for the future.

An encouraging development of the last decade or two is the great growth of interest in nature conservation. For many of us, young and not so young, it is the most practical way to ensure that something good in our environment will survive for our descendants. The work results from active co-operation between amateur naturalists and professional ecologists – many people are, in fact, both! One famous nature reserve, Wicken Fen, dates back to late Victorian times. It was given to the National Trust as almost the last piece left of the fast vanishing Fenland; ever since it has been managed by a local committee of amateur and professional ecologists. More recently, too, it is ecologists who have founded and guided the many county trusts for nature conservation who now own and manage a large number of quite invaluable nature reserves all over Great Britain. It is, perhaps, not sufficiently realised that without this dedicated work of conservation little would remain even now of our irreplaceable flora and fauna, and probably none at all by the end of this century.

Edward Goldsmith cannot really be ignorant of all this work, nor of its importance and urgency for the future of mankind and of all living things on our still beautiful earth. Why, then, does he wish to give the impression that *The Ecologist* belies its title, bites the hand that feeds it, and is not worth the attention of serious minded people? Our best hope for the future lies in a firm and confident alliance between amateur and professional ecologists, now and always so strong among naturalists and conservationists.

Yours faithfully,
William Palmer, M.A., F.L.S.
Cambridge.

A review of Hayley Wood, Its History and Ecology, appeared in The Ecologist Vol. 6. No. 2.

The work of the authors you cite does not provide the information required to guide public policy if it is to avoid destroying our natural environment. Perhaps you know of works provided by professional British ecologists in the last decades which can do so?

Conservation, in this country, is to all intents and purposes, effectively non-existent. The National Parks are not really National Parks at all, since they contain houses and villages and many of our most august scientists (Lord Zuckerman) have no objection to mining activities being carried out in them. The total amount of land taken up by statutory nature reserves in the country is 295,507 acres (0.4 of Britains land area) of which little more than 70,000 acres are in England. This is just over three hundred square miles out of a total land area of over ninety thousand square miles, which means that we are not willing to devote more than 0.3% of the land area of this country to preserving its natural life. Do you really think this is something to be proud of? Eugene Odum considers that a country should be at least 50% wilderness.

Editor

Where Angels Fear to Tread

Dear Sir,

I do not know what qualifies Mr. Seymour to write on agricultural matters (Letters to The Editor, *The Ecologist*, December 1975), for it is painfully obvious from his remarks on farm workers that he is totally unaware that those who are employed on the land have a great deal of responsibility. One of the first principles is the care of the land and livestock and one certainly needs self-discipline and a sense of responsibility for both.

One becomes somewhat out of sorts with the growing number of wretched refugees from the urban sprawl who, having done nothing to stop or rectify the destruction of the towns and cities they are leaving, scramble from their sinking ship and rush into rural sanctuary – then spend most of their time writing tracts on how we should run our countryside!

If Mr. Seymour's idea of a "sophisticated peasantry" is based on people of this ilk, then I can assure him that there are many who would wish him to show a little more humility, until he has served his apprenticeship in the time-honoured manner.

Yours faithfully,
M. J. Huntington, (Farmer),
St. Mawes,
Cornwall.

Perpetuating Dangerous Myths

Dear Sir,

Freedom of information, the right to know the truth, would free us from misinformation on fluoridation.

Since first hearing recommendations by medical authorities that fluoride should be added to those public water supplies alleged to be deficient in fluoride in order to reduce tooth decay in children I had always assumed that such authorities could be relied upon. I was far too busy to get involved in the fluoridation controversy and readily accepted what the "experts" said. I also accepted the view that people who were against fluoridation were cranks and I never bothered to listen to what they had to say or read what they wrote.

Last year I happened to be on platform at a meeting at which I was to speak on the subject of Ethics in Medicine. On the same platform was the Chairman of the National Anti-Fluoridation Campaign who spoke on the subject of fluoridation of public water supplies. I was a captive audience and for the first time heard something different from what I had previously been told.

I was intrigued, to say the least, and my curiosity to discover the truth soon led me to realise that my medical teaching had been quite incorrect. All the data I had been given on fluoridation by the medical authorities was basically untrue. The data had in it sufficient truth to make it credible but was so slanted and curved as to lead one to a conclusion which was entirely false.

It is almost certain that had I been engaged upon the task of teaching medical students I would have passed on to them the same errors as had been passed on to me. I have no shadow of doubt that no one who is untainted by vested interest would knowingly promulgate the myth that the fluoridation of public water supplies is a scientifically based remedy for dental caries. The vast majority of doctors just do not have the time to investigate the subject of fluoridation in depth; they take the word of those who teach them on the assumption that their teachers know the truth.

The outcome of my investigation is that I am now a confirmed opponent of the idea of adding fluoride to public water supplies and having looked into it I regard the campaign being carried out by the Department of Health and others in favour of water fluoridation as perhaps the best possible evidence of the need for a Freedom of Information Act to ensure that public authorities make available to the public such information as they have a right to possess.

I now take the view that all opponents of water fluoridation are providing a service of considerable value not only to the general public but to the medical profession in particular.

Yours faithfully,
Edward C. Hamlyn, M.C., Ch.B.,
Medical Adviser to the House of Commons All Party Committee on Freedom of Information.

Toxic Waste in Municipal Compost

Dear Sir,

If Bob Waller had read my *Fertility Without Fertilisers* thoroughly, even the *Contents* would have told him that he is totally inaccurate in saying that I "regard composting as the only way organic farming and gardening can be managed". I deal with leafmould, peat, manure, green manure crops, organic fertilisers and comfrey. My book is written for British organic gardeners, and therefore it does not mention Arthur Hollins, though in the last chapter it does refer to the late F. Newman Turner's herbal ley system which is the basis of most organic dairy farming. As the Ruth Stout system depends on "spoilt hay", which is too costly for use in Britain, I do not mention her either.

What is important is that though Bob mentions Professor Derek Bryce Smith, he appears to know little of lead pollution. He should read the article "Lead, Behaviour and Criminality" in your issue of December 1974 so he will understand just why, after about 25 years of work in this field (I wonder if Bob remembers the Dalscone Road compost plant at Dumfries, where J. C. Wylie began, I wrote that chapter in *Fertility Without Fertilisers.*

If Bob would read what I wrote, both in this book and in the pages of *The Ecologist* and *Compost Science* of America) he will see that there is a great difference between 1.6 dry tons spread over an acre in 12,000 gallons of water containing at most 700 parts per million lead, on farmland monitored by the A.D.A.S. for toxic metals, and about 10 dry tons an acre of Municipal Compost with 1,000 p.p.m. lead or more, spread on the surface of a back garden by a "no-digger". A pound of food a day at 2 p.p.m. is well over the danger limit for a child of three, one 500th of a pound is enough to suck off muddy fingers.

It may be easy for the manager at Leicester to convince Bob, but I would be more convinced by any record of the surface lead and cadmium levels from gardens where municipal compost has been used for 5-10 years. I would also appreciate any serious article replying to the work of Professor Bryce-Smith from anyone concerned with Municipal Compost, for the evidence is that there is an unanswerable case against the use of this substance because of its lead and cadmium content, because the Professor's work is never answered. It is supported by references and a great deal of hard work, and I am not prepared to gamble health and the soil that he is wrong. I am sure that *The Ecologist* would be glad to publish a refutation if he can be refuted.

The Ministry of Agriculture is producing safety standards for lead and cadmium. When these are produced I will have the latest news printed and gummed into all copies of *Fertility Without Fertilisers.* Until I am sure that Bob's "fight for composting" is not a fight for soil pollution, I am not joining in.

The responsibility lies with those who "sell" (in both senses of the word) municipal compost, to establish that it is safe.

Yours faithfully,
Lawrence Hills,
Henry Doubleday Research Association,
Bocking, Braintree, Essex.

We apologise to Mr. P. Jonquiere for an error in the second paragraph of his letter in the February issue of The Ecologist.

This should read:

The cultivation of groundnuts between rows of young rubber trees is not an appropriate way to cultivate rubber as the soil will be impoverished. This plant withdraws a lot of nutrients from the soil, especially during the formation of the fruit and also needs much water. For this reason, on Java, the practice of growing alternate yearly crops with rice in the paddyfields had to be discontinued owing to the adverse effects on the soil. On the other hand, growing *tobacco* and rice in alternate years was continued as the flooding of the land for rice cultivation destroys the wet-rot germs which are persistent. In Sumatra, fields which had grown only tobacco had to be left 7-8 years so that wet-rot could be controlled, and for this reason tobacco should not be cultivated as a catch crop.

Friends of the Earth

Action Alert!

1976 will probably be make or break year for energy policy in the U.K. Important decisions will be made by the Government which may commit Britain almost irrevocably to the electro-nuclear road. Later this year the Government will be announcing whether or not a demonstration Fast Breeder Reactor plant should be built. The diversion of resources into such a project would virtually foreclose any non-nuclear policy options.

Tony Benn has called for a public debate on energy policy and we intend to continue that debate. In January British Nuclear Fuels Ltd. organised a public debate on the reprocessing of nuclear fuels for the professionls. On April 24th Friends of the Earth will be organising public debates for the public to focus attention on the social, ethical and political implications of nuclear power.

CAMBRIDGE UNIVERSITY BRANCH OF THE CONSERVATION SOCIETY AND FRIENDS OF THE EARTH

SIZEWELL PICKET

On Saturday 24th April, we will be turning up in force outside the Nuclear Plant at Sizewell, on the Essex coast, to demonstrate that there is a large and growing public opposition to the proposed extension of our nuclear facilities in the short term, and to our expected much-increased reliance on Nuclear generated electricity in the long term. Sizewell is the site for the four new proposed Steam Generating Heavy Water Reactors, for which Government consent has already been given.

At the site we will be peacefully handing leaflets to the employees explaining why we are opposed to the further development of Nuclear Power. It is also planned to have music and theatre throughout the day, as well as refreshments, and other activities designed to illustrate our ideas and the available alternatives to nuclear power.

The Sizewell picket is one small part of a major three-pronged manifestation of public feeling on Nuclear Power, organised nationally by Friends of the Earth for April 24th. On that day, as well as the Sizewell picket;

1. people from London and all surrounding areas will be turning up at the Winscale plant and peacefully picketing. It is intended to build large new fuel reprocessing facilities there.
2. people in Scotland will peacefully occupy Torness, the site for two new proposed Steam Generating Heavy Water Reactors.

Further details of activity and the thought behind it will be forwarded nearer the time. (For further information please contact Rob Edwards, Jesus College, Cambridge. A message can be left on Cambridge 68611)

Nuclear Excursion and Rally

WINDSCALE
SATURDAY 24th APRIL

There will be a rally at Windscale at which the workforce and management will be invited to express their views. A train will leave London at 7.30 a.m. to take people to the rally, stopping at Watford, Birmingham, Crewe, Warrington and Preston.

The return fare for the Nuclear Excursion will be £5. Coaches will run to Windscale from other parts of the country, and to two other sites where developments are proposed: Torness (Scotland) and Sizewell (Suffolk).

For further details contact:-

Czech Conroy, Friends of the Earth, 9 Poland St., London W.I. 01-434 1684

Mary McClintock, F.O.E. Scotland, (Torness)

Rod Edwards, Cambridge Survival, Jesus College, Cambridge. (Sizewell)

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COMMUNE buying large mansion and land near Petersfield needs members. About £5,000 for family-size unit, smaller units possible many communal spaces. Chanan 125 Vansittart Road Windsor, Berks, SL4 5DG, Windsor 66745.

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PROPERTY

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NORFOLK, delightful smallholding, approx. 5 acres, in secluded, yet not isolated, timbered position, own water, mains electricity, full oil central heating, large vegetable garden, paddocks, outbuildings, stabling, garaging. Entrance hall with cloakroom, open plan reception hall/dining room, large kitchen, spacious lounge, conservatory, 3 bedrooms, bathroom, freehold. Offers around £26,000. Tel. Watton 881037.

ESTATE MANAGEMENT – Ecologist, Ph.D. in natural resource sciences, seeks position as consultant/manager wherein he can apply himself to the management of farm, forest and grassland holdings of large estates. Tel. (01) 435 9513 or Box PD100.

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