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## NUCLEAR POWER
## The Grand Illusion

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## Editorial



## Feature Articles



## Ecopolitics



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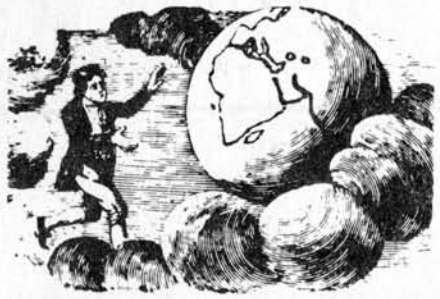


# The Weapons Connection

**Guest Editorial by Colin Sweet**

At a recent seminar on nuclear power costs held at the Institution of civil Engineers in London, the chairman, Dr David Widdicombe QC, put the proposition to CEGB representatives that they should release more information when requested to do so. Mr Widdicombe was putting forward the opinion of a number of specialists at the seminar who complained that it was impossible to check the figures on which the CEGB based their policy conclusions because neither the data on which those figures were derived nor the methodology employed was available. Specifically he asked if the CEGB would release the computer programme and the data on which it based its Net Systems Savings — an accounting method used to provide what it claims to be a reliable method of comparison between fossil fuel and nuclear power generation. Some of those present at the seminar were openly sceptical of this method, including the American energy consultant, Charles Komanoff, who said that it would be unacceptable in America. The senior CEGB representatives at the seminar, Mr Frank Jenkin, and Mr J Jukes, gave assurances that such information would be made available. If that promise is followed through it will be a welcome step forward.

The matter of the disclosure of information is an important one. There can be no public accountability without the disclosure of much more information than is available at the present time, and accountability is not to be separated from public acceptability.

Initially the fight that began as an expression of environmental concern and came to be known as the nuclear debate, was something of a debacle. For one thing the nuclear institutions tended to treat their critics as people who were abysmally ignorant, and not worth talking to. In the last few years the nuclear debate has moved towards becoming a serious one, but there is still further to go and undoubtedly the Windscale Inquiry was a step in the right direction. The next inquiry to be about the PWR will be an important test of whether the debate has passed the watershed especially in its terms of reference and the assistance given to objectors.

In fact the debate is no longer based on environmental questions, although they remain an important constituent. Rather it has become political. Indeed, in some countries it is an issue that can unseat governments, and already two countries in Western Europe have taken themselves out of the nuclear club. And there is always a chance that in the next General Election in Britain, it could be a major divisive issue. The nuclear institutions therefore are under serious pressure, and they have no one to hold responsible for that but themselves. Today, their response to questions fortunately contains less of the earlier arrogance, but it is still equivocal enough to cause the suspicions it arouses to exceed the satisfaction that it gives. As more information has been winkled out of the institutions, the concern, not only among the informed critics, but among the wider public and legislators has grown, rather than diminished. The result is that over the entire range of issues that nuclear power raises, there is a gulf that divides the nuclear institutions from the critical sections of the public. In sum, the nuclear industry faces a credibility gap which can be likened to that which existed in the early sixties over nuclear weapon strategies, or in the later sixties, to that which American governments experienced as they became more deeply entrenched in Vietnam.

As our government drives deeper into the shaping of a nuclear Britain it is surely no coincidence that it is spending more and more on defence, when in every other public sector it is ruthlessly cutting back.

The recent demotion of a senior official of the House of Commons because he protested at the systematic prevention of evidence being given to a Select Committee by high officials, shows just how alive the connection is between the civil and military use of nuclear power.

We know that nuclear reactors are the sole source of plutonium and we are bound to be curious as to how much plutonium from civilian reactors in the U.K. goes into weapons production. Not what weapons, (which might be held to be a legitimate secret), but how much? At Windscale, BNFL said that the plutonium stockpile was less than 10 tons. As we know that 4000MW capacity of Magnox reactors produces around two and a half tons per year, why is the stock so low? And given that it is low, what implications does this have for the viability of a fast reactor programme. Since we can only build up plutonium stocks through a thermal reactor programme, it might explain Mrs Thatcher's enthusiasm for the nuclear pathway, especially in view of her desire to be tough in foreign policy.

With two Magnox reactors down, and the others likely to peter out in the 1980's, where is the plutonium going to come from? Not the Fast Breeder. Because even if we could rustle up enough plutonium to start the programme, we have been told on the good authority of the AEA that the Fast Breeder is not likely to breed — at least not for 50 or 60 years.

Why the insistence on building what we patently do not need? The electricity demand figures tell us that we will have more capacity on the supply side than we need. Indeed, there has been no rise in demand since 1973. And when committed capacity comes on stream by the mid eighties, we will have greater excess capacity. In fact, there is no energy crisis, and for the U.K. at least there will be no crisis when the ten proposed PWRs

come on stream between 1988 and 1998. Rather there will be an embarrassment of high cost unwanted generating capacity. Why then place the order now? The possible answer — that we need more plutonium — makes good sense of a puzzling situation. Against all this background the CEGB seems to be behaving with new and discernable caution. Cast as the 'fall guy' who will have to buy and operate those unwanted producers of expensive electricity, the CEGB is beginning to change its role. Indeed, the clear statement of Frank Jenkin at the recent conference on nuclear costs, that the CEGB would order one reactor at a time, and not in series, is in contradiction to what David Howell argued before the Select Committee on Energy.

On the other hand, its caution may be a way by which the CEGB can gain some assurances before it proceeds that it will not have to meet all the economic losses of what is essentially a political decision.

The decision to plunge deeper into the unknowns of a large nuclear programme has all the flavour of a political push about it, and very little of that which would accompany a sound economic decision. Again the comparison with the military seems appropriate when we study the nature and scale of the propaganda campaign that is being launched. The large advertisements in the press appearing to offer information of an objective kind, under the cover name of Nuclear Power Group, (address 30 Millbank, London SW1, which happens to be the Electricity Council), and financed out of public funds, would seem to be breaking some rules and may even be of questionable legality. The educational programme of packages, films and speakers, is also publicly financed, and operated through link ups with public bodies. Ought this not be subject to some rules? The pressure on the media is less easy to question but is known to be very considerable. Meanwhile, the psychological attack of the campaign is directed (as in wartime) towards the basic human emotion of survival. 'The very fabric of our society is at stake', we are told and Fred Hoyle's "Energy or Extinction" is quoted with approval, although his thesis that there are numerous moles belonging to an international conspiracy working to bring down the West, is usually a little muted. The critics threaten us with "Back to the Dark Ages" to single out one high level cultural discourse that goes into the AEA package.

What we are witnessing are the institutions moving from the extreme of saying almost nothing to turning the debate into propaganda warfare. The association of such propaganda with nuclear power is no coincidence, and it should not be overlooked; still less, should it be shrugged off. The political forces ranged around nuclear power are far more extensive than the nuclear institutions themselves, and they have risen to its defence, in what they see as a threat to its survival. Inevitably they are going to make the public suffer the consequences of their propaganda. So that the public understands the truth about nuclear power, it is essential that the real motives behind government support for this energy form are brought into the open. That can come about only through challenging the government at every point.

Terry Why

# NUCLEAR POWER — The Grand Illusion

by
Peter Bunyard

Ever since her visit to France last May, when President Giscard d'Estaing took her around the Tricastin site of nuclear reactors and fuel enrichment plant, Mrs. Thatcher has been nursing her ambition to revive the flagging nuclear industry in Britain. Clearly she was impressed with the enormity of the French programme, the cheapness of French reactors compared to Britain's, and the French government's riding the storm of mass, bitter opposition to nuclear power.

Before its electoral defeat, the Labour government announced that two more AGRs (Advanced Gas Reactors) were to be built at Heysham and Torness on top of the existing AGR programme. This programme is still in the process of completion after what have been unprecedented delays and crippling cost over-runs. Mrs. Thatcher's government has confirmed its support for the Torness and Heysham decisions, but in addition has proposed a new programme to consist of ten reactors with a total capacity of some 15 gigawatts ($15 \times 10^9$watts). Work is to begin in 1982, with one new reactor to be started each year. The total cost of the programme is estimated at between £10,000 and £15,000 million, which amounts to an installation cost of over one billion pounds per reactor.

In essence the proposed nuclear power programme is a last-ditch stand against the ruthless arithmetic of rising demand for energy and an anticipated fall of indigenous petroleum and natural gas supplies. Indeed the government expects that even with 40 gigawatts of nuclear electricity installed by the year 2000 and production up to 155 million tonnes of coal a year, Britain will still have to import from between 35 to 120 million tonnes of coal equivalent energy, at an annual cost to balance of payments of £2.5 to £8.5 billion in 1977 prices. With an energy deficit costing Britain so dear, it would be utter folly, says the government, to forgo the contribution that nuclear power could make, and it has begun resurrecting the old Shibboleths: nuclear power is safe, clean and cheaper than fossil fuel electricity generation. As for the opponents of nuclear power; they are increasingly branded as dangerous and anti-social.

**The French Nuclear Programme**

With its coal, gas and oil, Britain is clearly in a more favourable energy position than France, yet the French example in putting a large nuclear programme into action is one that the British government would like to emulate.

France has limited coal and virtually no oil or gas, but as in Britain and the rest of Europe, petroleum consumption has multiplied more than tenfold since 1950 and in 1973, at its peak comprised two-thirds of primary energy consumption. Even before the Yom Kippur War and the ensuing oil embargo by the members of Arab OPEC, the French government had been anxious about its dependence on such large volumes of imported oil, and was already turning to American Westinghouse light water reactors as the next reactor type to follow on from its natural uranium graphite moderated gas-cooled reactors — the twins of our Magnox reactors. The multiplication of oil prices in 1973 together with the politics of oil dependence spurred the French government into action and in 1974 it brought out the Messmer Plan which committed Electricite de France — EDF — to building five or more reactors a year at least until 1985, by when sixty per cent of France's electricity would be nuclear generated, catering for a seven per cent annual increase in French electricity consumption. By 1985 electricity generation will not only have doubled but the nuclear contribution will be greater than the total generating capacity of all sources just ten years previously in 1974. Meanwhile more than twenty per cent of France's primary energy will be derived from uranium compared to a few per cent at the present time. According to the French government, its nuclear programme will be a major step towards France gaining its energy independence sometime in the early part of the next century while still maintaining a growth economy.

Having embarked on the construction of two 900 MW(e) PWRs at Fessenheim and four at Bugey in the early 70s, L'Electricité de France took on the Messmer Plan in 1974 with its 'Contrat Pluriannuel 1' consisting

of 16 units of 900 MW. Five reactors were begun in 1974, six in 1975 and five again in 1976, with the assumption that each reactor would take no more than seven years from start to finish. In 1976 EDF began CP 2, the plan being to build eight reactors in all, again of 900 MW(e). Over and above the thirty 900 MW units either completed or under construction, EDF has also embarked on its 1300 MW(e) programme. Two such units were begun in 1976 and 1977, another five in 1978 and 1979 and five more are proposed for 1980. Still more sites have been earmarked for future 1300 MW PWR stations.

Compared to the aggressive French programme, with reactors being built practically on an assembly line, and without even a 'wait and see' period to ensure that the first reactors on stream work properly, the British programme, as announced by David Howell, is relatively paltry — just one reactor each year for ten years from 1982. Even so, some half dozen reactors will have been built in the new British programme before the first started comes on line. It will be interesting to see whether the British government will build a succession of PWRs under those circumstances. Undoubtedly Mrs Thatcher and her team of pro-nuclear enthusiasts will be watching with great curiosity how the French fare.

**Pushing Up Electricity Consumption**

The French nuclear programme has been justified on the grounds both of providing energy self-sufficiency and on the assumption that electricity consumption in France will continue to grow at its historic growth rates. Between 1950 and 1973, electricity consumption in France increased at a rate of seven per cent each year, thus quadrupling overall. Electricity consumption is also expected to double again between the mid 1970s and 1980s despite a slowing down in the growth of primary energy consumption. So far EDF's projections appear to be going to plan and between 1977 and 1978 electricity consumption in France grew by 6.7 per cent compared with a 2.2 per cent growth in primary energy. Furthermore, between 1973 and 1978, corresponding to an accumulated growth in gross national product of 14 per cent, electricity consumption grew by 28 per cent and primary energy by only 4.2 per cent. EDF also claims that 80 per cent of total growth in electricity consumption in 1978 has been covered through bringing into service the Fessenheim and Bugey reactors. With so many plants being built and coming on stream in lumps of 5000 megawatts ($5 \times 10^9$ watts), EDF will have to make its forecast of demand for the 1980s self-fulfilling; otherwise it will have an embarassing electricity surplus on its hands, and moreover will have to operate a significant proportion of its nuclear reactors as load followers rather than as providers of base-load electricity, so adding considerably to generating costs.

An obvious and popular way to stimulate electricity demand is to keep the cost down to the consumer and EDF has embarked on a vigorous campaign to inform the public that nuclear generated electricity will cost little more than half that generated from coal or oil by 1985. To add to the propaganda, President Giscard d'Estaing announced in late January that because nuclear electricity was cheaper, those living within a 20 kilometre radius of a nuclear reactor would have 15 per cent slashed from their electricity bills. His enticement failed to appeal to the citizens of Plogoff in Brittany who are demonstrating vigorously against the proposed nuclear power station there.

Meanwhile EDF has engineered substantial outlets for its projected generating capacity by persuading builders to install electric water and space heating schemes into new buildings. As many as 40 per cent of all new buildings are now provided with mains electricity heating.

The success of EDF's campaign to increase consumption has led to a situation in which present generating capacity can hardly match demand. In December 1978, during a particularly cold spell EDF had hastily to import electricity from its neighbours, Belgium and Germany, but even so the strain on the grid was too great and large areas of the country were blacked out. For the Parisians the experience was traumatic, and both the government and EDF have used it to press through with the fuelling of both the recently completed Gravelines and Tricastin reactors even though welding cracks have been found in the heat exchanger plates and reactor vessel, and to keep the Bugey reactor in operation despite radiation leaks between the primary and secondary cooling circuits. EDF's message to the public during the winter of 1979 to 1980 was unequivocal: "if you don't want black-outs this winter, we must keep Bugey running; anyway it's safe."

Unfortunately for those wanting an expanded nuclear programme in Britain, the way seems beset with problems; thus the CEGB (Central Electricity Generating Board) has difficulty increasing consumer demand, which, with a generating surplus on its hands over and above the level of spare capacity considered necessary as a safety margin, hardly justifies enormous expenditure on new plant. On the other hand economists of the UKAEA such as Dr Peter Jones are at pains to point out that early retirement of conventional coal-fired plants in favour of nuclear replacements would bring a cost savings to the consumer. The Coal Board hardly agrees: Dr K R Shaw stresses in *Energy Policy* December 1979 that the real costs of nuclear power are doubling or even quadrupling every decade and that an expanded nuclear power programme in Britain would cost an extra £2 billion more each year than an equivalent coal-fired programme.

Meanwhile Thatcher's government has artificially put up gas prices to get consumers away from that premium fuel — supposedly to buy electricity instead. Presumably the increased revenue from gas will go towards subsidising the nuclear programmes. Will the British consumer increase his electricity consumption coincident with the government's plan for electricity expansion? If he does not, and trends indicate a certain reticence, any expansion of electricity supply will be billions of pounds down the drain. An active programme of energy conservation combined with the saturation of energy consuming markets, household heating and transport for example, could lead to the low energy strategy for the UK envisaged by Gerald Leach and his colleagues, described in great detail in their book for the International Institute for Environment and Development.

**The Energy Balance Sheet**

The French take the role of nuclear power more seriously than the British, indeed in France the big selling gambit for nuclear reactors is that they will take the country towards self-sufficiency in energy. But this is wishful thinking. To begin with a vast amount of increasingly expensive petroleum must be used to build nuclear power stations and allied installations, fuel that could otherwise be used to satisfy France's normal day to day requirements. (See *The Ecologist* Oct-Nov 1979)

Meanwhile the Eurodif enrichment plant at Tricastin which is being built in cooperation with the other European countries is designed to produce enough enriched fuel for some 80 units of 900 MW (e) or more than double France's nuclear energy capacity during the eighties. Yet its own consumption of energy which is to come from four reactor units built on the same site will be close to 30 billion KW hours *which is approximately the total electricity consumption in France in 1950.*

In *Le Dossier Electronucleaire* the CFDT has made a tentative analysis of the energy costs entailed in building the French nuclear power programme, and compared those costs to the expected useful energy output from the reactors once working. Thus 1.24 tonnes equivalent of petroleum are required in installing one kilowatt of nuclear power and 0.27 tonnes of petroleum equivalent in the provision of nuclear fuel. That finding leads CFDT to the conclusion that if EDF obtains its objective "Tout electrique tout nucleaire" the energy balance of the French nuclear power programme will be in the black only sometime between the eleventh and sixteenth year of starting the programme. Thus *it will be after 1985 and possibly as late as 1990 before France begins to benefit in energy terms from its nuclear programme.* Meanwhile France is paying the cost in increased dependence on fossil fuels, in particular petroleum and in substantial borrowings from American banks.

**Uranium Availability**

For France to achieve energy independence her nuclear programme must be based on indigenous sources of uranium. France has between two and three per cent of all known recoverable reserves of uranium in the world, and a quick calculation shows that the 60,000 tonnes of recoverable reserves of uranium will hardly last the 32 reactors under construction or ordered between 1970 and 1978 more than a decade; considerably less in fact than their supposed lifetime of some twenty to twenty five years. Indeed a 900 MW(e) PWR such as Fessenheim's number one reactor requires fuelling each year with 30 tons of enriched uranium which corresponds to some 180 tonnes of natural uranium. By 1985 the entire Contrat Pluriannuel 1 should be on stream which together with the Fessenheim and Bugey reactors will make demands for some 5,600 tonnes of natural uranium each year. With the second Contrat Pluriannuel and the 1300 programme following hard on the heels of CP 1, France's uranium requirements will exceed 9000 tonnes.

At present three indigenous mines, Vendee, Limousin and Forez produce 1400 tonnes of uranium each year, which on the basis of 180 tonnes per reactor per year provides for no more than eight 900 MW(e) units. In 1977 France was importing fifty per cent of its uranium requirements, mostly from the Niger-Gabon area of Africa. By 1985 the contribution of France's indigenous uranium to its overall requirements will have fallen to less than 25 per cent and it will need to import from wherever it can, South Africa, Canada, Australia, as well as Central and West Africa.

In France the need for uranium has led to a major effort to expand indigenous production. COGEMA, an offshoot of the CEA — and somewhat equivalent to BNFL — hopes to get production up to more than 3000 tonnes of uranium per year by 1982, both by expanding existing mines and through developing new ones. But a good percentage is to come from sedimentary rocks which have to be heated to more than 1000°C in order to release the uranium. No industrial plant is yet in existence for roasting the ore, and even when it is there is no surety that the exercise will be worthwhile. Indeed the energy consumed extracting the uranium could be greater than the energy derived from its use.

The CEA is also experimenting with a technique by which sulphuric acid or sodium hydroxide is injected through bore-holes into uranium-bearing rock and the dissolved uranium is then pumped out. To improve yields the CEA proposes using explosives which will fracture the rock and subsoil. In the Brugeaud mine where the procedure is being tested the CEA reports that from five to ten cubic metres per hour of groundwater are infiltrating into the dissolved uranium solution and diluting it. What of the reverse process by which the acid solution flows out of the mine and contaminates groundwater supplying a reservoir for human consumption?

Self-sufficiency in energy through its nuclear programme would seem to be utterly illusory. To compound the irony the French government insists that France should have at least a two-year stockpile of uranium so as to avoid temporary shortfalls brought about through what are euphemistically termed 'delivery problems'. In his report *L'Etat de L'Atome,* Yves Lenoir, a systems engineer at the French School of Mines in Fontainebleau, maintains that by 1985 France's uranium needs will be eight per cent of world production. With its two year stockpile and given the rapid expansion of its nuclear programme, *France is therefore seeking to control fifteen per cent of total world production.*

When the Messmer Plan was mooted in 1974, other European countries as well as Japan and the United States had plans of their own for substantial nuclear power programmes. If those plans had proceeded as intended world uranium production would barely have kept pace with demand in 1982, according to an OECD survey. Whether France would have been able to procure its two-year stockpile if the rest of the OECD countries had gone 'nuclear' in their attempt to break the hegemony of oil is another matter. A Euratom report of 1975 assessed that 90 per cent of the Common Market's uranium would have to come from Third World Countries during the 1980s. 'One of the essential tasks of the EEC,' proclaimed Euratom. 'will be to protect the community's enterprises in Third World countries against political risks.' France did not wait to learn its lesson. In 1974 the then-president of Niger was so rash as to promise his countrymen that he would nationalise the uranium mines — under French control — and multiply the price of uranium tenfold. In April of that year, the president was ousted in a coup d'etat with the conspicuous help of French forces.

As far as resources go, uranium is hardly in the same energy league as petroleum. *One assessment of total world recoverable reserves of uranium puts the energy yield obtainable from thermal reactors at no more than one fifth of that in remaining reserves of petroleum.* A recent Horizon programme on the BBC emphasized the point by showing uranium prospectors from all over the western world homing in on a major find of very high grade uranium stretching over some 200 miles around Lake Elliot in the wasteland of Canada. By the year 2000 all the uranium from that one superb site would last the world no more than two years.

The problem is not one of total uranium resources which, scattered throughout the earth's crust and the oceans, are immense: it is more a matter of the quality of the ore. The United States for example has some of

the world's most important uranium reserves, and Federal estimates put the better grade ones with an uranium content of at least 500 parts per million and an extraction cost of less than 30 dollars per pound, at 3.5 million tonnes. Yet the ratio of finds to drilling for uranium has been dropping steadily and some experts suggest that the then Energy Research and Development Agency - now the Department of Energy — may have overestimated US high grade uranium reserves by a factor of two or three. In addition only two thirds of uranium in a mine is extractable; hence the usable uranium reserves may be as small as one to 1.5 million tonnes.

If low grade uranium reserves included then the grand total or uranium in the United States is boosted considerably. The Tennessee shales for example have uranium concentrations of between 10 and 100 ppm, the better shales having an average uranium content of 25 ppm. Overall the shales represent a resource of 10 to 15 million tonnes of uranium oxide, and if the uranium could be extracted at a cost of 100 dollars per pound, then acording to Anthony Nero of the Lawrence Laboratories in Berkeley California, the cost might be economically tolerable.

> "However such low grade resources have little effective energy content (ie the amount of electrical energy ultimately made available per mass of mined ore) and below about 50 ppm," he points out "the energy extracted is no greater than that from coal, assuming the uranium is used in the current LWR fuel cycle.
>
> "Considering how vigorous the processing of this ore must be (using $H_2SO_4$) and the problem of disposing of the tailings, the ores are very unattractive. The same may be said of granite ores with uranium contents of about 10 ppm. Of the low grade sources, certainly the most attractive is seawater, but its concentration is so low (0.003 ppm) that economic extraction is not anticipated."

With the figure of 3.5 million tonnes, the US uranium reserves could support no more than 700 light water reactors since a 1000 MW(e) LWR consumes some 5000 tonnes of natural uranium during its lifetime. In 1974 the US Atomic Energy Commission anticipated between 850 and 1400 reactors by the year 2000, with a cumulative demand by then of one to three million tonnes of uranium oxide. In 1976 the nuclear contribution to the total 500 gigawatt generating capacity of the United States was close to 10 per cent. A more probable growth of nuclear power in the US by 2000 than that forecast by the AEC is between 200 to 300 gigawatts, inasfar as some 150 GW are either under construction or operating at the present time. Even that number of reactors would consume the likely recoverable reserves of uranium amounting to some 1.5 million tonnes.

Ironically the escalation in fossil fuel prices since the early 1970s has not brought about the expected response in terms of the ordering of new nuclear power stations, except in France and the USSR, where opposition is either scant or overridden. The reasons for the faltering programmes in the majority of countries are mixed and include strong environmental opposition, an unexpected escalation in costs brought about by a combination of delays and cost-over runs as well as substantial increases in safety and ancillary equipment, and in countries such as Britain by a substantial falling off in the growth of electricity demand. Overall the combined effect of these influences has been to slow down the ordering of new nuclear stations, and has led to an excess of available uranium. But that glut would be shortlived if nuclear power programmes based on straightforward thermal reactors would once again get underway.

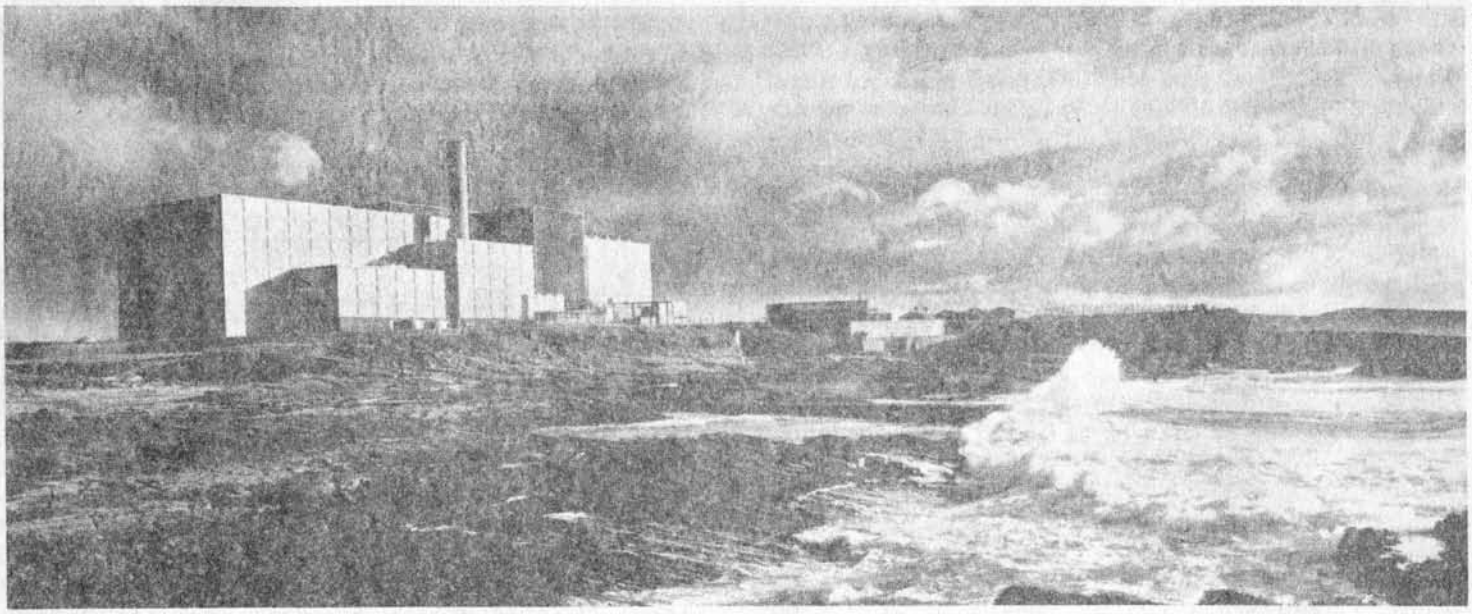
**The Fast Breeder Reactor**

$$\text{U 238} + \text{1 neutron} \longrightarrow \text{U 239} \xrightarrow{\beta^-} \text{Np 239} \xrightarrow{\beta^-} \text{Pu 239}$$

Countries such as France, Britain, Japan and West Germany, which either have virtually no uranium resources of their own, or limited resources, see the fast breeder reactor as the ultimate means of escape from dependence on uranium imports with their political and economic overtones. The expectation in France and the UK in particular is that fast reactors will become commercial propositions over the next twenty years. The purpose of the breeder reactor is to generate more fuel than is consumed and at the same time to generate electricity. All reactor systems bring about the breeding of fissile material from fertile material, but the conversion ratio in most thermal systems is substantially below one, thus indicating an overall diminution of fissile material. Because they use natural uranium rather than enriched uranium, and hence have high proportions of uranium-238, the Magnox reactors used in the UK and the Candu reactors used in Canada, breed considerably more plutonium than do either light water reactors or Britain's AGRs. However by using a moderator, whether it be graphite, heavy or light water, the neutrons of thermal reactors are slowed down and consequently are less likely to be captured by a uranium-238 nucleus which then transforms into plutonium. (If thorium-232 is used for breeding as has been suggested both for the Candu and High Temperature Reactor systems, then thermalised neutrons are more effective than fast neutrons). The fast reactor works on the principal that neutrons with undiminished speeds, some 10,000 times faster than thermalised neutrons, are more readily captured by uranium-238 and hence will bring about enhanced breeding of plutonium-239. But because the chain reaction proceeds with greater difficulty with fast neutrons, the fuel must be far more enriched - up to 20 per cent or more - than is necessary in thermal reactors which can either operate on natural uranium or fuel enriched to some 3.5 per cent, depending on reactor type. At present the most ambitious fast reactor programmes are being carried out in the USSR, in France, followed by Britain, West Germany, Japan and the United States, where some 500 million dollars per year are being spent on fast reactor R and D despite a withholding of support on the Clinch River fast breeder by President Carter.

In the West, France is involved in the most ambitious fast reactor programme with Phenix in operation since 1973 at Marcoule, and Super-Phenix under construction at Creys-Malville. The 1240 MW(e) Super Phenix should be completed a little behind schedule in 1983, and plans are already being drawn up for its successor, the aim being to find ways to reduce the cost of construction by eliminating superfluous safety factors. The French situation is curious in that L'Electricité de France has the principal share in the venture rather than the Commissariat a L'Energie Atomique.

By extrapolating from experience with Phenix which at 250 MW(e) is the same size as Britain's prototype fast reactor at Dounreay, the French expect Super-Phenix



UK Atomic Energy Authority

Dounreay Fast Reactor in Scotland

to breed some 165 kilograms of plutonium each year out of an initial charge of 5.5 tonnes of plutonium — the plutonium gain being three per cent. The fuel of the fast reactor will be contained in 364 assemblies each with 271 stainless steel pins, 2.7 metres in length and 7.1 millimetres in diameter. Each pin will contain a mixture of plutonium and uranium oxides, the plutonium amounting to some 17 per cent of the total. The fuel is to be in the central portion of the pin, with natural uranium oxide at either end to make up the axial blanket. Surrounding the core of fuel pins is the rest of the blanket comprising some 233 assemblies, each with 91 pins of 15.8 millimetre, this fertile section containing pastilles of impoverished uranium. At the end of each year's operation half the core section will be taken out and replaced with fresh fuel and one quarter of the radial blanket.

**Reprocessing is the Achilles' heel of the nuclear industry . . . when millions of curies of fission products are released from fuel assemblies.**

According to Walter Marshall, deputy chairman of the UK Atomic Energy Authority, the fast breeder is something of a misnomer in that its production of plutonium per gigawatt-year is actually less than other reactor systems, including PWRs. Thus a Magnox reactor will yield 600 kilogrames of plutonium per gigawatt year, and a PWR 275 kilogrames. In fact there is an actual overall consumption or incineration of plutonium in the core of a fast reactor, and that loss is made up only by the breeding which goes on in the radial and axial blanket regions. According to Marshall out of 2.8 tons of plutonium that are used to fuel a one gigawatt reactor some 220 kilograms are consumed in the core while 409 kilograms are gained in the blanket. Maximum production with the blanket in place is thus 189 kilograms per gigawatt-year — a figure higher by 13 per cent than the anticipated figure for Super-Phenix with its rather larger plutonium inventory.

**Reprocessing: The Achilles' Heel**

But to talk of plutonium production in a fast reactor and actually to make use of bred plutonium is another matter. *Reprocessing of fast reactor fuel is a vital, integral part of the fast reactor concept not only to extract the plutonium bred from the blanket, but also the considerable quantities, amounting to several tons, still unconsumed in the core.* Indeed whereas some nuclear experts consider reprocessing of spent thermal oxide fuel from AGRs and PWRs an option, and an expensive one that given the relative high cost of reprocessing compared to the cost of freshly mined uranium, the reprocessing of fast reactor fuel will always remain an urgent necessity in a programme consisting of more than a full sized demonstration reactor.

Without doubt, reprocessing is the achilles' heel of the nuclear industry, being the point in the fuel cycle when the millions of curies of fission products, actinides and activation products associated with the spent fuel from one reactor are released from the fuel assemblies. The purpose of reprocessing is primarily to extract plutonium and unconsumed uranium while at the same time containing the remainder of fission products and other radioactive contaminants in a state that the authorities consider safe. But one hundred per cent containment of nuclear wastes would be wholly uneconomical even if technically feasible, and all categories of wastes, including solids, liquids and gases are discharged within special authorisations. The principles behind the authorisations is to prevent the total cumulative discharges exceeding a population dose on average of more than 1 rem per person in 30 years. To safeguard individuals, members of the public must receive no more than 0.5 rems in any one year.

Experience with reprocessing fast reactor fuel is very limited, approximately one ton having been retreated over a period of ten years in France. Meanwhile in Britain a small pilot reprocessing plant has recently been commissioned at Dounreay for treating spent fuel from the prototype fast reactor. The problem with reprocessing is that the technical difficulties and the risk of serious accidents increase commensurately with higher burn-up of the fuel.

Fuel from military reactors has a low burn-up of several hundred megawatt days per tonne resulting in a radioactivity of approximately 100 curies per cubic

metre. Reprocessing to extract weapon-grade plutonium presents no fundamental technical problems, although it creates high level waste which has to be kept in stainless steel tanks with continual refrigeration and stirring to prevent heat build up and the settling out of solids. Similar reprocessing techniques have been developed for Magnox fuel with its burn up of up to 5000 megawatt-days per tonne, again with the production of high level waste and of medium and low-level waste, some of which is discharged into the environment. Reprocessing of Magnox fuel and the French equivalent UNGG fuel has been carried out on an industrial scale at Windscale in Cumbria, and at Cap de La Hague in the Cotentin peninsular of Northern France. Corrosion of the magnesium alloy cladding when the spent fuel is put in cooling ponds has given BNFL some headaches at Windscale, primarly because of the escape of caesium-137. In the early 1970s BNFL had to ask for authorisation to increase its discharges, particularly of beta-emitters and in 1977 alone it discharged 121,000 curies of caesium-137 out of a total beta-emitter discharge of more than 192,000 curies.

On account of the corrosion problem, reprocessing of spent Magnox fuel is considered mandatory, and both France and Britain have gained considerable reprocessing experience on this fuel alone. As pointed out, the reprocessing technology as applied to Magnox fuel is considerably simpler than that needed for higher burn-up fuel. Yet Magnox fuel reprocessing has hardly had a satisfactory record. The industrial plants have aged very rapidly, giving no more than 10 to 15 years service before needing to be replaced. The discharge from the reprocessing plants, into the atmosphere and sea is already close to the authorised limits, themselves raised, and the workers in the plants have been subjected to relatively high radiation doses which come in the range of those found to enhance the risk of cancer. The history of reprocessing hardly bodes well for the future when high burn-up fuels are used. Much of the poor publicity in Europe concerning reprocessing plants has been directed against Cogema, the operators of Cap de la Hague, who have been accused of subjecting the reprocessing workers to awful working conditions on account of radiation leaks. Indeed at the end of 1976 the reprocessing workers at Cap de la Hague went on strike for better conditions. But a simple comparison of the two reprocessing plants using official figures shows Windscale in an even worse light than Cap de la Hague. Under its authorisation Windscale is permitted to discharge 300,000 curies of beta emitters each year and up to 6000 curies of alpha emitters. Cap de la Hague is permitted to discharge 45,000 beta and only 90 curies of alpha. In 1978 Windscale discharged 64 per cent of its beta allowance and 31 per cent of its alpha. Since Cap de la Hague has a throughput one third that of Windscale, the latter on a weight per weight basis is actually discharging one and a half times more beta than the French reprocessing plant is authorised to discharge and seven and a half times more alpha. In 1978 Windscale discharged more than ten tonnes of uranium, and some 48,000 curies of plutonium-241, itself a beta emitter, which, with its half life of 14 years, then decays into the longer lived alpha emitter americium-241. Like other alpha emitters, americium gradually builds up on the environment; like them too it is extremely radiotoxic.

Already the marine food chain shows signs of radioactive contamination, particularly of caesium, and an avid eater of plaice and crab from the Irish Sea in the offshore Windscale area could, according to official figures, attain up to one third of the dose limit as recommended by the ICRP (International Commission on Radiological Protection). An eater of 5 grams per day of locally caught molluscs, could derive more than 10 per cent of his dose limit from ruthenium-106 and americium-241 contamination. The question remains whether the radioactive dose has been properly assessed, and whether the assumptions behind the dose response and the generation of cancer are correct. Recent evidence points to a 10 or even 20 fold underestimation of the carcinogenic effects of radiation, particularly of low fractionated doses of alpha emitters.

As for the reprocessing workers at Windscale, on average they receive twice the radiation dose of their counterparts at Cap de la Hague, whose average individual dose per year appears to have levelled off at approximately 0.5 rems per year. The average dose to workers concerned with production is considerably higher, reaching more than 4 rems in 1974 at Windscale. Clearly too, the more workers employed the lower the average dose even though total radiation leaks into the working environment may be higher. According to one report (Apre/Lebdo No. 194 28th May 1976) out of 8 cases of leukaemia among Cap de la Hague workers, three of the victims were aged between 40 to 50 and were classed as occupational deaths. Meanwhile the risk of children born with spina bifida to reprocessing workers appears to be 10 times above the French national average.

Enriched thermal oxide fuel used in AGRs and LWRs has a burn-up of 18,000 to 33,000 megawatt-days per tonne which gives it a radioactivity four to five times higher than that of magnox fuel. In principle the same chemical process is used and both Cogema and BNFL are proceeding with plans to erect reprocessing plants which can deal with high burn-up oxide fuel. Both companies have stated that the new plants will work satisfactorily and with a reduced discharge into the environment. Both companies have also signed contracts with Japan to receive several thousand tonnes of spent thermal oxide fuel for reprocessing, and have been promised pre-payments to go towards the massive installation costs, amounting to more than £600 million.

**BNFL's confidence in reprocessing thermal oxide fuel on an industrial scale is in stark contrast to actual experience.**

The confidence expressed by BNFL and Cogema is in stark contrast to actual experience in reprocessing thermal oxide fuel on an industrial scale. None of three plants built in the United States were working when President Carter imposed his moratorium on reprocessing in 1977 (to prevent weapon proliferation through the acquisition of plutonium). In the six years it was running from 1966 to 1972 Nuclear Fuel Services of West Valley in New York State operated at a load factor only 30 per cent of its design; moreover its workers received average radiation doses per year above the recommended limits of 5 rems. At Windscale a head end plant was built to feed into the existing magnox reprocessing plant. It began operation in 1969 with an

expected capacity of 400 tonnes but had reprocessed only 120 tonnes at the end of 1973 when a blow-back of ruthenium-106 contaminated more than 30 workers, some heavily, and the plant was closed for good. The Haute Activité Oxyde plant at Cap de la Hague was brought into service in 1976 with the reprocessing of 15 tonnes of spent fuel from the Swiss reactor at Muehleberg, but it had to be shut down for improvement in order to afford better radiological protection to the workers who meanwhile went on strike. When the plant came back on stream in November 1977 it worked nowhere near its expected capacity of 400 tonnes a year, achieving barely more than 10 tonnes a month. In December a dissolver became blocked and caused a pile up of 100 kilograms of fuel, which was uncomfortably close to a criticality accident. In early 1978 the HAO plant was shut down and the plant, like its Windscale counterpart returned to being used solely for Magnox fuel reprocessing. In Japan a new thermal oxide reprocessing plant was commissioned in 1977 with a nominal capacity of 200 tonnes a year. By August 1978 the Tokai Mura plant had broken down for technical reasons after reprocessing no more than 19 tonnes.

Both Britain and France have accumulated plutonium through reprocessing metallic fuel from their respective Magnox programmes. In the future both countries will have to resort to reprocessing thermal oxide fuel if they are serious about developing the fast reactor. By 1990 the French programme of LWRs will give rise to 1000 tonnes per year of spent fuel, and worldwide the amount could run into many thousands of tonnes. The cumulative quantity of spent fuel could be as high as 85,000 tonnes by 1990, at which time there would have to be some dozen reprocessing plants in operation each with a working capacity of 1000 tonnes per year. By the year 2000 some twenty such plants would be required.

Fast reactor fuel, with a burn-up of 80,000 to 100,000 megawatt-days per tonne, is many times more radioactive again than thermal oxide fuel; moreover it has a high content of plutonium, with added dangers of criticality. Any reprocessing of fast reactor fuel is still very much in the research and prototype stage, with the Commissariat a L'Energie d'Atome in France trying out a dry process in addition to the conventional Purex method used in most reprocessing plants. In the wet process insoluble particles, likely to capture plutonium and possibly bring about a criticality accident, are a particular problem. The particles have to be captured on filters leading to an activity of up to 10,000 curies per kilogram with a heat discharge of up to 10 kilowatts. Aside from a special geometry to prevent accumulation of excess plutonium, special neutron absorbers are used in the solvent, the best available being rare earths such as hafnium and gadolinium which are by definition scarce and expensive. In time these become poisoned by neutron bombardment and have to be replaced.

The handling of fast reactor fuel once out of the reactor is technically as demanding as the safe operation of the reactor itself. At the moment of discharge the residual activity in each fuel element amounts to 30 kilowatts, and for a period of up to 20 days, while the spent fuel is retained in special containers next to the reactor, this heat must be dissipated. Any breakdown in the cooling could cause the fuel elements to melt giving rise to an accident at least as bad as that of a nuclear excursion in the reactor itself.

At the end of that period the residual activity has fallen to 7.5 kilowatts on average, and the fuel assemblies are taken out and immersed instead in either liquid sodium or a sodium-potassium alloy in special metallic containers. As with sodium coolant used in the reactor all contact with air and water must be avoided. The operators of Super Phenix reckon that some 20 tons of sodium coolant will be required each year for the transport of the fuel assemblies from the reactor to reprocessing plant, the containers themselves being contained in 60 ton fortified casks. The sodium meanwhile will become contaminated through leaking fuel elements and by neutron activation. Again any loss of coolant could be disastrous.

*In distinction from thermal reactors in which the fuel must be in the most reactive configuration, the fuel in fast reactors is not in its most reactive configuration.*

Thus, meltdown of fuel elements in a thermal reactor, although a hazardous event to be avoided, carries no danger of criticality and a nuclear explosion. The fuel of a fast reactor can however melt into a more reactive configuration thus giving rise to a nuclear excursion. *Meltdown of the fuel elements, whether inside the reactor, during transport or while waiting for reprocessing, carries considerable dangers.*

**Should there by no net plutonium gain, the expansion of nuclear power would be limited to the availability of uranium — 235**

*The fate of nuclear power hangs on the efficiency, safety and economics of reprocessing.* The rationale for the fast reactor is that it will both increase the total energy extracted from uranium by a factor of 60 or more over and above that achieved in a purely thermal programme, and that any country which has accumulated a large stockpile of uranium can by dint of plutonium become independent of uranium suppliers. For that reason Giscard d'Estaing talked of France attaining twenty fast reactors by 2000. But the efficiency of reprocessing and its safety are very much in question, an indication being the substantial discharges of radioactive waste including plutonium and alpha emitters. Any plutonium losses above a few per cent of the total passing through the reprocessing and fuel fabrication plant, and the plutonium gain at the end of each fuel cycle could be jeopardised. *Should there be no net gain, expansion of nuclear reactors would be limited to the availability of uranium-235.*

Some 19,000 tonnes of spent fuel with an average burn-up of 1000 megawatt-days per tonne have been reprocessed at Windscale, the plutonium losses are estimated at more than 7.5 per cent; indeed between 1971 and 1976 almost 20,000 curies of alpha-emitters - or 266 kilograms of plutonium - were discharged into the Irish Sea. Fuel fabrication accounts for further losses, most estimates being in the range of five per cent. *Overall plutonium losses may therefore be as high as 12 per cent.*Assessments of the plutonium losses incurred during reprocessing and fabrication of high burn-up thermal oxide fuel and of fast reactor fuel indicate that they may be equally high. Not only will those plutonium losses affect the net gain, but they will lead to serious environmental pollution. With 500

gigawatts (500,000 MW) of fast reactors, 1200 tonnes of plutonium would have to be retreated each year out of which 30 tonnes would be lost in the wastes should the rate of loss be 4 per cent. *As much as one tonne of plutonium could be discharged into the sea each year, amounting to nearly 100,000 curies.*

The plutonium lost during fast reactor fuel fabrication finishes up with other wastes which therefore have to be stocked in such a way that they remain out of contact with the environment for thousands of years. Another problem is likely to arise when fast reactor fuel is recycled, for should it contain as much as 8 per cent of plutonium-241 then the gamma and neutron activity would be such that workers could remain in contact with it for no more than a few hours each week. With fission products in the fuel as well, their time would be limited to a few minutes each week. Reprocessing plants at present release all Krypton-85 and tritium; as much as one million curies of krypton 85 being discharged and 10,000 curies of tritium into the atmosphere each year from Windscale and as much as 30,000 curies of tritium being discharged into the Irish Sea. When reprocessing is expanded in order to provide plutonium for fast reactors, then the efficiency of waste control will have to improve commensurately if environmental discharges are to remain within the same authorisations. Moreover tritium and krypton 85 will somehow have to be contained. At what cost?

At present the annual radiation dose averaged out over the entire world population amounts to 0.2 millirad which is trivial compared to a natural background radiation dose of 100 millirems per year. But the contribution of nuclear power to world energy is also trivial, being no more than one per cent. Should nuclear power increase its contribution to total energy by a factor of 200, thus substituting for fossil fuels and providing for world energy growth, and should routine radiation emissions remain as high as at present, then the average radiaton dose to the individual could increase to 50 per cent of background — hardly a welcome prospect.

According to Professor Patricia Lindop, radiation physicist at St. Bartholomew's Hospital, *the efficiency of present discharge rates for alpha emitters will have to improve by a factor of 100 if Windscale is to expand as expected by 2000* and still remain within present authorisations. With the introduction of the fast reactor, some 500,000 curies of plutonium and 40,000 curies of americium will have to be reprocessed just for a single 1000 MW(e) reactor. Ultimately the nuclear industry will have to achieve containment factors of more than one billion. Thus no more than one atom out of 1000 million will be allowed to escape.

**Doubling Time**

The breeding of plutonium in a fast reactor is usually assessed in terms of doubling time. A doubling time of 30 years thus implies that after operating for that period a fast reactor would have generated sufficient plutonium to fuel both itself or its replacement as well as another reactor. The doubling time depends first and foremost on the amount of plutonium bred in the reactor — the plutonium gain — but it also depends on the rapidity with which the plutonium can be got back into the reactor after reprocessing and on the relative percentages of plutonium lost during reprocessing and fuel fabrication.

If Super Phenix produces a surplus of 165 kilograms each year out of 5.5 tonnes of its initial plutonium load, then the doubling time would be just over thirty years. If however it takes one year to reprocess and fabricate spent fuel then the doubling time of a single reactor increases by 50 per cent, if two years by 100 per cent and so on — that is assuming the fuel stays in the reactor core for two years. With a programme of fast reactors and the implementation of a programme of reprocessing to keep pace with spent fuel, then the overall doubling time of the reactor group will be 0.7 of the doubling time of the single reactor. What about plutonium losses? *If these should amount to as much as 6.5 per cent then they would cancel out completely any plutonium gains and extend the doubling time to infinity,* at least in Super Phenix in which 165 kilograms of plutonium are bred in a total of 2.5 tonnes of plutonium taken out of the reactor at the end of a year's operation. *Any losses above 6.5 per cent would mean that fuel for the working reactor would have to be made up from an outside source — a thermal reactor.*

To keep the total inventory of plutonium as low as possible in a fast reactor programme, the operators must try and reprocess spent fast reactor fuel as soon as they can after extraction from the reactor core. Indeed with Super Phenix 2½ tons of plutonium are bound up in each refuelling operation, an amount obtainable only after 10 years of LWR operation. The residual radio-activity in the spent fuel diminishes rapidly after extraction from the reactor, although after one-third of a year cooling, its gamma activity is still 50 times higher than that of PWR spent fuel which has been cooled for five years. The hope is to be able to recycle the plutonium in less than a year, including fuel cooling time, reprocessing and fabricating. To achieve that rapid recycling Chauncey Starr of the US and Walter Marshall of the UKAEA have proposed a completely automated reprocessing system which allows certain fission products to pass through with the stream of uranium and plutonium. The reprocessed fuel could therefore contain fission products with a gamm-activity level comparable to that of 5-year old spent PWR fuel. Fuel fabrication would also have to be automated and Marshall has proposed a gel process now under investigation at Harwell. Whether such a process — termed the Civex process — would work efficiently and safely at an industrial level is simply not known, nor has it even been tried out at the laboratory level.

**"The potential danger from fission products resides in their accumulation: 40 billion curies of caesium-137, 25 billion curies of strontium-90, 600 million curies of plutonium, 350 million curies of americium and two billion curies of curium."**

*H. Mouney, EDF*

The future of the fast reactor would therefore seem to be on very shaky ground. The methods of reprocessing tried at the industrial level give rise to large plutonium losses which may exceed the gains made in the reactor. And in order to recycle the fuel promptly after extraction from the reactor, fuel will have to be handled with very high radiation levels. Proposals for automating fast fuel reprocessing are at the early experimental stage, and may prove impossible to scale up. What would happen in an automated plant if radioactive residues built up to dangerous levels? Would that

situation have to be overcome by building in multiple redundancy, and at what cost?

**High Level Waste**

Reprocessing also gives rise to high level waste which at present is contained in double walled stainless steel tanks embedded in concrete. The strontium-90 and Caesium-137 in particular with their half lives of around 30 years need to be contained for more than 500 years; actinides in the wastes, including plutonium-239 with its 24,400 year half life, necessitate safe containment of the wastes for up to one million years. As H. Mouney of EDF points out "the potential danger from fission products resides in their accumulation: 40 billions of curies of caesium-137, 25 billion curies of strontium-90, 600 million curies of plutonium, 350 million curies of americium and two billion curies of curium."

In the EEC in 1980 high level wastes should amount to 1,300 cubic metres, by 2000, some 70,000 cubic metres will have accumulated. Since each cubic metre of concentrated high level waste liberates 200 kilowatts of heat ten years' after reprocessing, continual cooling and stirring is mandatory. Should the cooling fail and nothing be done to repair it or transfer the contents of the tank to another tank, the solution in the tanks will begin to boil after several hours and release radioactive gases. Furthermore plutonium in contact with water in the presence of oxygen, aluminium or silicon, can form a mixture whose critical mass is less than seven grams of plutonium per litre.

All nuclear authorities consider the vitrification and then burial of these high level wastes as the ultimate solution. The French are probably the most advanced with a pilot plant at Marcoule which is supposed to be capable of vitrifying 150 cubic metres of wastes each year. In one experiment with thermal oxide fuel the CEA found that each cubic metre of glass emitted 150 kilowatts and the radiation dose at three metres was some 1000 rems per hour. After vitrification the glass has to be stocked on concrete vaults, cooled with forced air which attains a temperature of 180°C on exit. Should the pumps fail, the glass will rapidly heat to melting point. The encapsulated waste must therefore be kept in its artificial environment until the residual heat has fallen to levels below those of melting the glass. The notion is then to bury the wastes in 'stable' geological strata, or to drop them in the middle of the ocean, or possibly to fire them in a rocket into outer space. *No scientist can guarantee the stability of rock structures, the durability of the glass considering the continual heating and irradiation, nor the reliability of space shots.* To exacerbate the industry's problems the proposed dumping of high level waste is becoming a major environmental issue. Again the high level waste from fast reactors presents even more thorny problems. *Its activity is such that it will have to be diluted in three times more glass and even then the glass is likely to attain temperatures of 600°C, leading to a more rapid deterioration of the glass itself.*

**Uranium Mining**

During routine operation reprocessing is the most polluting of all stages of the fuel cycle. Second to it is uranium mining. Therefore when the British nuclear industry compares the hazards of coal mining with its own remarkably safe record and paucity of deaths, it is not comparing like with like. Indeed by not having a uranium mining industry of its own in Britain, the nuclear industry can quietly forget the penalties incurred elsewhere. Hard rock mining is hazardous on account of a high accident rate, silicosis brought about through inhaling dust and on account of radon.

One of the better know epidemiological studies and the first to pinpoint the dangers from radon, was that carried out on the miners of Jachimov and Schneeberg on the Austrian-Czechoslovak border. As the table shows the miners had a fiftyfold higher chance of dying of lung cancer compared with the population in Vienna.

**MORTALITY PER THOUSAND INDIVIDUALS**

| | Jachimov miners | Schneeberg miners | Viennese population 15 to 79 years |
|---|---|---|---|
| Period | 1928 to 1938 | 1895 to 1912 | 1932 to 1936 |
| Lung Cancer | 9.8 | 16.5 | 0.34 |
| Other cancers | 0.7 | 2.1 | 2.1 |

In the early 1970s, as a consequence of recommendations by the ICRP, the International Commission on Radiological Protection, the US AEC began to impose rigorous measures to reduce radiation levels in American uranium mines. The radiation dose to workers is now measured in working levels; thus a miner who works 170 hours each month during the course of the year, must receive no more than a total of 4 working level months to comply with the ICRP. In radiation dose terms he should breathe air with a maximum radon content of 30 picocuries per litre ($30 \times 10^{-12}$ curies/litre) which taken in over the full working year, would give him a radiation dose to the lungs of some 15 rems per year. His whole body radiation dose, meanwhile must not exceed 5 rems per year.

Before 1970 uranium miners in the United States were not protected from radon exposure. A study of 3366 uranium miners indicates that their mortality is practically double that expected, there being 437 deaths from accidents and lung cancer against an expected mortality of 277. Estimates of cumulative working level months received by the miners over the course of their work shows a strong relationship between dose and cancer. Above 3720 WLM the lung cancer rate was 25 times higher than expected; between 120 and 359 WLM it was more than four times higher; at an exposure rate of 2.7 WLM per year — which is less than ICRP recommended maximum permissible dose — the lung cancer rate was more than doubled.

Despite the growing evidence that uranium miners are at considerable risk from radon and its radioactive daughters, the French government has agreed to limits of 600 picocuries per litre of air, which is twenty times higher than ICRP recommendations, and which brought about a five-fold increase in lung cancer among American miners. The CEA has given a reason for the higher limits: if the ICRP recommendations were adopted then only 20 per cent of world uranium reserves could be exploited at reasonable cost.

Mining and quarrying for uranium produces millions of tons of tailings. At Brugeaud for example after ten years' quarrying, a hole 130 metres deep and covering 15 hectares has been created for the production of less than 2000 tonnes of uranium. Some 20 million tonnes of rock tailings have been put on one side, from which radium and thorium-230, both with long half lives, leach out into the soil and waterways. The CEA admits

that radiation levels in the vicinity of the mine are likely to be six times greater than those around nuclear reactors. *In the United States the Environmental Protection Agency estimates that radon from some tailing piles will give a radiation dose of 8 rems at 50 metres distance and 0.3 rems nearly one kilometre away during the course of a year. In 1976 measurements taken on a tailings pile at the French mine at Monts D'Ambazac indicated radiation levels between 12 and 120 times the maximum permitted concentration.* Meanwhile the solvent used for extracting uranium from its ore in treatment plants also becomes radioactive, reaching a radium concentration as high as 1000 picocuries per litre. These liquids have to be retained in special lagoons, but leaching and environmental contamination is inevitable.

At various public lectures spokesmen for the UKAEA have pointed out that the nuclear industry is benefiting the world by eliminating natural radioactivity through the burning of uranium in reactors. They also state that coal-fired stations release more radioactivity into the environment than equivalent sized nuclear reactors. The notion that uranium extraction leads to a diminution of danger to man is erroneous. Most uranium deposits are shielded from weathering with the result that both uranium and its decay products leach with relative slowness into the environment, ultimately to be washed into the sea. The potential for environmental contamination is enhanced a million times in the reactor core, where the long life and low radioactivity of uranium is obliterated by the chain reaction and a multi-million year process is made to take place in a matter of moments.

Containment of fission products in the reactor is essential; yet even so there are considerable routine emissions. On the other hand there is little attempt to date to contain the emissions from coal fired plants. A theoretical study by J P McBride and his colleagues at the US Oak Ridge National Laboratories indicates that emissions from nuclear reactors and coal-fired plants are not so very different. Radon released through the chimney stack is the most significant radiological hazard from burning coal, and the scientists estimate that the releases to the atmosphere per megawatt-electric per year amount to some 23 grams of uranium, 46 grams of thorium together with 1.2 x 10°° curies of radon.

By contrast the mining of 1500 tonnes of uranium — enough to refuel annually eight 1000 MW(e) LWRs brings about the release of 1000 to 10,000 curies of radon — a quantity one hundred to one thousand times more than is released by an equivalent sized coal programme.

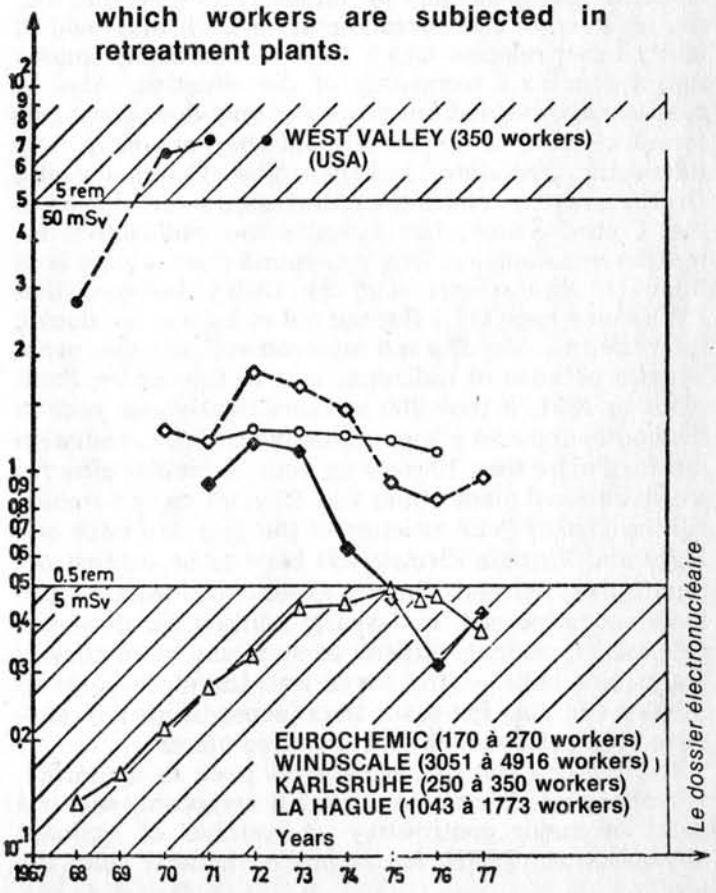
**Routine Emissions**

At the same time the routine operation of nuclear power plants and their ancillaries lead to a slow, inexorable rise in background radiation levels with almost imperceptible increases in the numbers of those dying from cancers and genetic diseases. Radioactive wastes are emitted in a routine manner both to the atmosphere and to the sea. Indeed certain radionuclides such as krypton 85 and tritium are released in their entirety from nuclear installations, containment being zero. The theory is that these substances will be simply diluted into the atmosphere in which they will be present only in harmless quantities. According to William Boeck, chairman of the Krypton 85 Working Group of the International Commission on Atmospheric Electricity, most krypton 85 released at Windscale, will recross the UK on its way around the world, while the rest will spread both north and south to other countries, resulting in the contamination of the global atmosphere. The Windscale plant alone during its lifetime, will introduce about 230 million curies of krypton 85 into the environment; a quantity about 20 million times the natural background. Environmental contamination by krypton 85 alone will be unacceptable once plans to reprocess all spent fuel are put into action.

Tritium is also released in large quantities from nuclear installations. A typical PWR releases 50,000 curies a year. Tritium is simply radioactive hydrogen and once it becomes a constituent of water it finds its way easily into human tissue: the maximum allowable dose in human tissue is at present only one thousandth of a curie.

Aside from unacceptably high plutonium emissions, Windscale increased caesium emissions to the Irish Sea between 1972-1976 from 25,000 curies a year to 136,000 curies a year. BNFL's claim supported by the National Radiological Protection Board (NRPB) is that it will be diluted to harmless levels even though caesium with its beta and gamma radiation is concentrated in living organisms, and is highly dangerous. Professor Blackith of Trinity College, Dublin points out that caesium is only diluted by 13 per cent before it reaches the coast of Ireland. Thus the Irish Sea as a whole is now contaminated with this very poisonous substance. These and other radionuclides discharged at Windscale are building up in the sediment of the Irish Sea at a rate much faster than their annual rate of disintegration. Moreover the extent of this routine contamination of the environment will inevitably and dramatically increase with growth in the number of nuclear reactors.

**Variation in the average annual dose to which workers are subjected in retreatment plants.**



**Accidents at nuclear Installations**

Accidents at nuclear reactors also contribute to environmental contamination. In 1978 there were 2835 in the United States and 1600 in West Europe, including hair line cracks, corroded pipelines and failing heat exchanger systems. Most incidents are followed by radiation releases. A recent report from West Germany indicates that every three days one of the country's reactors suffers some incident, most with radiation releases.

In France, officials at EDF and the CEA insist that the fissures recently detected in reactor pressure vessels and heat exchanger plates being manufactured in the Framatome workshops and presumably to be found in those reactors undergoing completion or in service, are no threat to the safe operation of the reactors at least for six years of operation. During that time techniques will be developed for following the progress of the fissures and for carrying out remote control welding and repairs. Critics, including Dr. Shoja Etemad who resigned from his position as senior research engineer with Framatome, paint a very different picture. They both claim that the cracks may spread at a rate far faster than officials in the industry admit publicly and that no technique exists for carrying out the repairs once the pressure vessel is *in situ*.

Water at the temperature and pressure required for PWR operation is extremely corrosive and once the stainless steel lining covering the inner black steel has been eaten through, the fissures will spread with great rapidity, giving rise to the possibility of pressure vessel failure. An accident of that kind could make Three Mile Island pale into insignificance. Similarly breaches of the heat exchanger plate could lead to loss of coolant and pressure with consequent build-up in steam and a possible explosion. According to Etemad, a fundamental problem with PWRs is for the operator to know the level of water in the reactor during an incident of the kind which struck Three Mile Island. Moreover, even if the controls are wholly automated — so as to eliminate the possibility of human error compounding the incident — the instrumentation itself may lead to faulty interpretation which then automatically guides the reactor to a worsening of the situation. Also as reactors age beyond ten years not only does their performance tend to deteriorate but they are subject to increasing radiation leakage. The Commonwealth Dresden reactor, one of the oldest commercial PWRs in the United States, has become too radioactive for routine maintenance. One way round the problem is to flush out the reactor and the Utility believes that PWRs may have to be flushed out at least twice during their lifetime. Repairs and replacements are also problematic because of radiation, and at the Indian Point plant in 1971, it took 700 workers nearly one year to dismantle and refit a heat exchanger owing to radiation levels of more than 10 rems an hour. A similar effort in a conventional plant would take 25 workers two weeks. All the Turkey Point reactors of the Florida Power and Light and Virginia Electric will have to be extensively repaired or replaced. Finding experienced workers who have not surpassed their yearly permissible dose will become increasingly difficult as more and more nuclear plants are built — the times and therefore costs of repairs will also increase; thus jeopardising any supposed competitiveness with coal-fired plants.

No full size fast reactor has yet been in operation. Whether such reactors can be made acceptably safe is a point of major controversy. A number of eminent physicists at CERN for example, believe that the technology should be abandoned on a count of safety alone. *Besides five tonnes of plutonium in the core, the fast reactor contains 6000 tonnes of liquid sodium coolant at a temperature of between 400 and 600°C. In contact with air such sodium burns spontaneously; in contact with water it produces hydrogen and caustic soda.* Sodium fires have occurred as at the Shevtchenko fast reactor in Russia, and safety problems in general have made the Russians cautious about the rate of expansion of their fast reactor programme. *As it happens no technology exists at present for controlling sodium fires which involve more than a few hundred kilograms.*

Should sodium leaks occur in the secondary heat exchanger, causing hydrogen formation, then automatic safety devices come into operation to shut off the coolant circuit and to flare off the hydrogen, like burning gas from an oil well.

Although sodium is not corrosive in the same way as pressurised water, it has *a high affinity for carbon which it drags out of the steel reactor vessel and fuel cladding bringing about embrittlement and a loss of structural properties.* Ageing effects in fast reactors must therefore be watched very carefully.

The Doppler effect by which a rise in temperature in the reactor brings about a fall in reactivity is extremely important as a means of control in fast reactors. Nevertheless situations can be envisaged in which their chain reaction becomes runaway and uncontrollable.

One possibility is that the sodium pumps fail. With the reactor shut off, natural circulation of the sodium by convection should take care of residual heat in the reactor, so far so good but what would happen if the control rods fail to fall into the core - a probability evaluated at one chance in 10 million per year? Within ten minutes the sodium begins to boil followed at a temperature of around 1700°C by the cladding around the fuel melting. The interaction of relatively colder sodium and hot molten fuel could provoke a great release of energy — estimated by the CEA at 560 million joules. The vaulting and the containment dome above it are supposed to withstand an explosion of 800 million joules, or the equivalent of 200 kilograms of TNT.

According to the Centre National de la Recherche Scientifique (Commission 06) "certain critical elements, such as the reactor vessels of Framatome or the vaulting of Super Phenix have not been designed on the basis of safety coefficients but purely on the basis of what is technically feasible." The ability of the vaulting and dome to take the maximum credible explosion is therefore suspect.

Other possibilities exist whereby a dangerous nuclear excursion can arise in fast reactors. Since the core is not in its most critical geometry, a shifting of nuclear material in the core could give rise to an excursion. Such changes could be brought about by a misplacing of a fuel assembly, by a rupture of fuel cladding, by the ejection from the core of a control rod through sodium vapour pressure, or by the deformation of the core hindering the movement of control rods. In fact reactivity can increase extremely rapidly in a fast reactor — at a rate closer to that of the chain reaction sustained in an atomic device than that found in thermal reactors. Should the coefficient of multiplication pass a certain threshold the power of the reactor will double very rapidly, multiplying by as much as 1024 in a millisecond. A number of explosions could result, with the breaching of all containment. At the

end of a year's operation a fast reactor of the size of Super Phenix contains between 10 and 25 billion curies.

However unlikely the event of a major explosion in a fast reactor it must be taken into account because of the fearful consequences. Reprocessing plants are possibly even more vulnerable than reactors insomuch as they have not been designed to withstand large explosions and the discharge of massive amounts of radioactive substances. In 1976, at the Cologne Institute of Nuclear Safety some engineers carried out studies on the gravest accident they could envisage for a reprocessing plant, and *they concluded that a radiation cloud, thousands of times bigger than that of Hiroshima could envelope an area downwind from the plant and kill many millions of people.*

As Zhores Medvedev, now working at the MRC in London, has exposed, a disaster involving nuclear waste led to the evacuation of about thirty villages spread out over an area of 200-300 square kilometres in the Urals. Twenty-three years later this devastated area still appears to be uninhabited.

**Capital Costs**

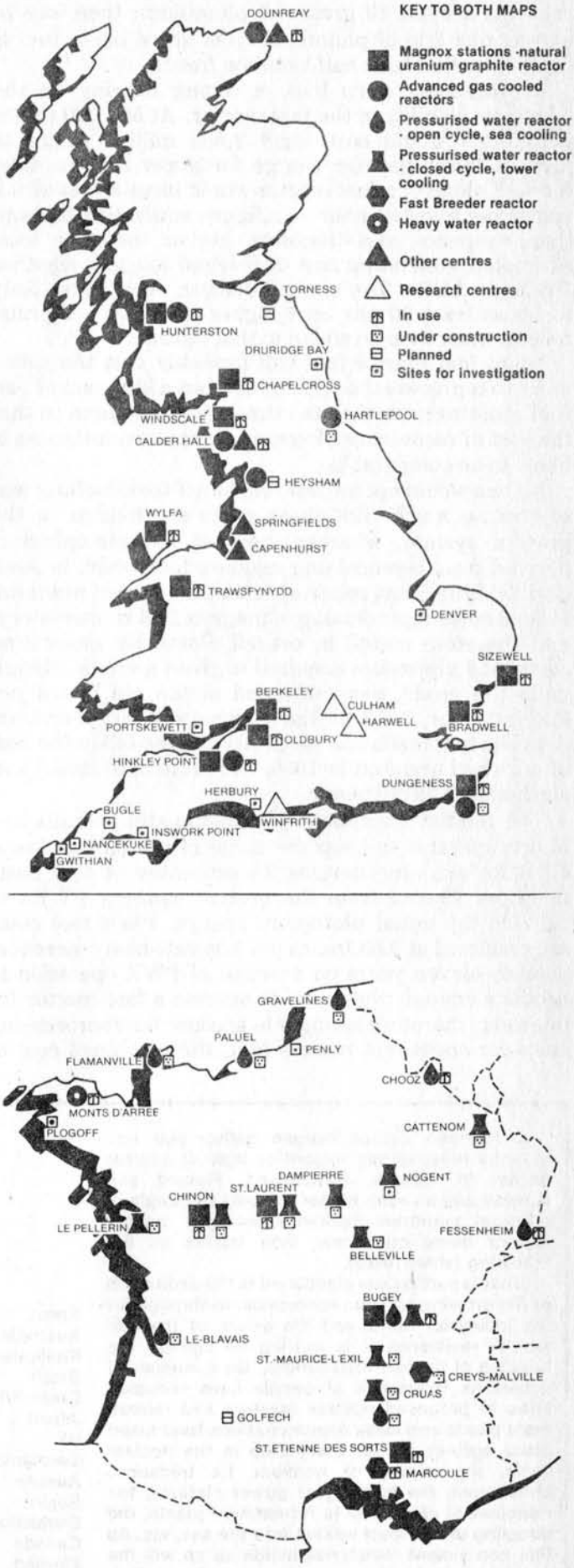
The costs of nuclear reactors are particularly high, in fact they account for two-thirds of the cost of nuclear electricity. What is more their cost of construction has been steadily increasing as the price of fossil fuels, vast amounts of which are required for their construction, escalates and as it becomes necessary to bring about an increasing number of modifications in order to satisfy increasinly stringent safety regulations. It is largely because of their high cost that 200 nuclear reactors have been cancelled in the US since 1973. The last one to be cancelled in New York was expected to cost $3 billion. The costs of French nuclear reactors appear to be very cheap by comparison — about a third of this price — the reason advanced by the French nuclear industry is that they are mass produced whereas the American equivalents are built one at a time. In reality the cost of French reactors is higher than admitted since the figures quoted make no allowance for inflation during the time of construction, contrary to practice in the US where utilities must make a provision for inflation which can sometimes add 65 per cent to the estimated price of a reactor. The EDF's present investment in nuclear power appears to be around 300 million francs or £40,000 million and a considerable part of this is to be borrowed from American banks: another reason why the French dream of energy independence via nuclear power is so totally illusory.

**Operating Costs**

In the US, public concern about safety, even before Three Mile Island added considerably to the cost of nuclear power, thus diminishing its competitiveness with coal fired plants, even when fitted with pollution controlled technology as demanded by US Federal laws. Present policy in the US is not to reprocess hence the costs of waste disposal are uncertain. Indeed the industry is having great difficulty in finding a suitable and acceptable waste repository.

In France and the UK reprocessing spent fuel is increasingly a costly component of the fuel cycle: moreover reprocessing is deemed necessary both to cope with Magnox spent fuel and to provide plutonium for fast reactors. The costs of reprocessing in both countries are comparable and *have escalated some twenty fold since 1973.* At that time the CEA evaluated

## Sites of Nuclear Power Stations in France and in the United Kingdom




Maps not to scale

the cost of treating one kilo of thermal oxide fuel at 290 francs. Soon, according to some estimates, the cost of reprocessing one kilo will have mounted to 10,000 francs, or close to £1,000. A kilogram of spent oxide contains around 10 grams of plutonium; therefore to extract one kilo of plutonium from spent oxide fuel is likely to cost at least half a million francs.

Reprocessing costs have a strong bearing on the economic viability of the fast reactor. At 500,000 francs per kilo it would cost some 2,665 million francs to provide the initial fuel charge for Super Phenix, thus the fuel alone of a fast reactor would incur a cost of 0.2 francs per kilowatt-hour — a figure equivalent to more than twopence and therefore higher than the total estimated generating cost of thermal reactors whether PWRs or AGRs. The capital charges, which are likely to be at least 50 per cent higher than for a thermal reactor must then be added to that figure.

Spent fast reactor fuel will probably cost ten times more to reprocess than oxide fuel, but a kilogram of fast fuel contains more than ten times the plutonium so that the cost of recovering plutonium in the two instances is likely to be comparable.

No one would opt for fast reactors if their fuelling was to cost so much. But these costs are hidden in the present system, whereby most of the plutonium is derived from reprocessing magnox fuel which is itself derived from using relatively cheap sources of uranium. Indeed since reprocessing of magnox fuel is mandatory, and therefore costed in overall electricity generating costs, any plutonium acquired is given a credit. (Originally the credit was estimated at 0.3 old pence per kilowatt-hour, but with the discovery of large uranium deposits in Canada and Australia and the fall in the cost of enriched uranium in 1956, the plutonium credit was slashed to 0.05 old pence.)

The relative cheapness of uranium still prevails and hence operates to keep the value of plutonium down. EDF for example derives its estimates of fuel costs of Super Phenix from the cost of running PWRs to provide the initial plutonium charge. PWR fuel costs are reckoned at 0.03 francs per kilowatt-hour; moreover it takes eleven years on average of PWR operation to produce enough plutonium to operate a fast reactor for one year, therefore taking into account the reprocessing costs for spent fast reactor fuel, the combined cost of


Creys Malville. Mass demonstration against construction of Super Phenix.

running the PWRs and the one year of fast reactor gives an average fuel cost of 0.044 francs per kilowatt-hour. The plutonium credit meanwhile amount to no more than 0.0036, which is almost negligible. Hence by EDF's reckoning running fast reactors is hardly more expensive than running PWRs. But what happens when the costs of PWR fuel escalate, with the rising costs of reprocessing, and what happens when fast reactors are self-generating, and the cost of fuel depends solely on reprocessing and not on the availability of cheap uranium?

"Certainly the fraud will be exposed once they begin recycling plutonium produced in fast reactors," comments Yves Lenoir in *La Gueule Ouverte* (January 24, 1979) "Not that recycling will take place tomorrow on account of the extreme difficulty in reprocessing that kind of fuel."

Without doubt the nuclear industry has seriously underestimated the costs of many essential components of the nuclear cycle, some of which, such as the storage of high level waste, the recycling of thermal oxide fuel and the decommissioning of commercial reactors, have never yet been successfully achieved on a commercially significant scale. Estimates of the price of disposing of military wastes have ranged from 2 billion to 20 billion dollars which provides some measure of the uncertainty that exists about the costs of such extremely delicate undertakings. Estimates of the costs of decommissioning are equally uncertain. The House of Representatives Committee (See *Nature* 11th May 1978) went so far as to state that "when the still unknown costs of radioactive waste and spent nuclear fuel management, decommissioning and perpetual care are finally included in the rate base nuclear power might prove to be much more expensive than conventional energy alternatives such as coal." It is only by seriously underestimating these costs, many of which have not yet had to be sustained, that the nuclear industry can pretend that nuclear electricity is cheaper than that provided by other sources of power. The extent to which the public has been deluded on the economics of nuclear power must slowly become clear as more information about the critical components on the nuclear cycle becomes available.

**A fourteen nation Morgan gallup poll has recently revealed big majorities against nuclear power, in Canada, Switzerland, Finland and Norway and an even bigger majority of people in different countries against allowing a nuclear reactor being built near their homes as the following tables reveal.**

**What is particularly significant is the dedication of the growing anti-nuclear movement throughout the industrial world, and the extent of the non violent resistance it is putting up against the building of nuclear installations. On a number of occasions thousands of people have occupied sites of proposed nuclear reactors and retreatment plants and mass demonstrations have taken place against almost every step in the nuclear cycle, the mining of uranium, its transport, enrichment, the building of power stations, the transport of spent fuel to retreatment plants, the dumping of low level wastes into the sea, etc. As this non violent resistance builds up so will the nuclear industry become correspondingly less economic and politically viable.**

| | Increase/ develop nuclear power | Stop/ don't expand nuclear power | Can't say/ Don't care |
|---|---|---|---|
| | % | % | % |
| Korea | 65 | 11 | 24 |
| Australia | 52 | 35 | 13 |
| Phillipines | 45 | 46 | 9 |
| Brazil | 42 | 41 | 17 |
| Great Britain | 42 | 42 | 16 |
| Japan | 42 | 26 | 32 |
| US | 40 | 45 | 5 |
| Germany | 39 | 45 | 16 |
| Austria | 33 | 45 | 22 |
| Spain | 30 | 50 | 20 |
| Switzerland | 27 | 65 | 8 |
| Canada | 25 | 55 | 20 |
| Finland | 13 | 82 | 5 |
| Norway | 12 | 83 | 5 |

| | Oppose nuclear power station near them |
|---|---|
| | % |
| Norway | 69 |
| Finland | 68 |
| Switzerland | 57 |
| Spain | 53 |
| Australia | 50 |
| Austria | 48 |
| Canada | 47 |
| Great Britain | 42 |
| Phillipines | 39 |
| Brazil | 32 |
| Japan | 31 |
| Korea | 28 |
| West Germany | 21 |

**Public Hostility**

A final factor which must militate against the success of Mrs Thatcher's nuclear programme is public hostility to nuclear power. This is building up very rapidly throughout the world. In Holland a 1979 referendum revealed that 72 per cent of the electorate was against nuclear power, thus leading to a temporary moratorium on the building of any more reactors. In Sweden a recent referendum showed that 43 per cent of the electorate was now against nuclear power with only 41 per cent in favour of it. In France 61 per cent and in West Germany 62 per cent of those under 35 are now against it. In the US after the Three Mile Island accident 53 per cent of the population were found to be against nuclear power with only 26 per cent in favour of it. In Britain too public opinion is swinging very rapidly against the nuclear option. A confidential poll by Information Research Centre showed that in just one year between 1977 and 1978 the proportion of the population in favour of nuclear power fell from 61 per cent to 49 per cent.

**Conclusion**

Nuclear energy cannot conceivably replace oil as a means of powering an expanding industrial economy. Today nuclear power provides 14 per cent of our electricity which in its turn makes up only 12 per cent of total energy use. It is likely to remain an insignificant source of energy for a number of reasons. Firstly, electricity use is likely to increase at a very slow rate in the coming years because of the growing world economic recession and general impoverishment. Even the CEGB now expects no more than one per cent growth in electricity consumption per year in the UK. This paucity of growth must deprive the Nuclear Industry of its main argument for more power stations. Secondly, the availability of uranium will become increasingly speculative, as a result of political turmoil in African countries from which much of it is derived, and because exporters throughout the world are likely to take full advantage of predictable shortages to increase prices just as the OPEC countries are doing with oil.

In addition attempts to build fast breeder reactors capable of generating their own fuel will run into all sorts of intractable difficulties. Thus their ability to breed in any significant way is open to doubt, both because of the slowness of breeding rate and because the loss of plutonium during reprocessing is likely to be greater than that generated during their operation.

The conclusion to be drawn is that the total population of breeder reactors functioning at any one time must depend on the amount of plutonium made available by the conventional nuclear power programme.

Although these devices are still in the experimental stage and incomparably more dangerous than conventional nuclear reactors, France and the USSR are continuing to build large unit-size plants. The chances of a serious accident are high, which would put paid to any continuation of the British FBR.

Reprocessing high oxide fuel from PWRs and ultimately that from FBRs has never yet been achieved on any industrial scale and the chances are that it may never. Meanwhile pollution of the Irish Sea by routine emissions from the Windscale Retreatment plant and of the English Channel by emissions from that at Cap la Hague are likely to grow, with increasingly intolerable levels of different radionuclides in fish obtained from these seas. Inevitable accidents at both these retreatment plants will lead to further contamination of marine life and of the surrounding countryside.

Undoubtedly the public will demand ever higher safety standards which if implemented will add to the rising costs of building and operating nuclear installations.

The problem of disposing safely of high level nuclear wastes is unlikely to be solved, and efforts to bury these wastes in some isolated part of the country will meet with such obstinate local opposition as to be unfeasible without violating basic democratic principles.

All these factors will lead to the construction of nuclear installations becoming ever less economic as well as politically unacceptable. Far from getting her reactors Mrs Thatcher is likely to find the nuclear industry slowly grinding to a halt, having revealed itself to be the biggest white elephant of the Industrial Era.

# When the Creys-Malville Breeder Reactor Burns Down

Last year, my colleagues and I launched the Geneva appeal. It was signed by hundreds of Swiss academics. We described the problems associated with the building of breeder reactors and the terrible vulnerability of the plutonium economy. Among other things, we compared the consequences of "a major accident to a breeder, however improbable, with those of a nuclear war."

Among the distinguished signatories of the Geneva Appeal, there was a French politician from the Polytechnique — the educational establishment that provides the bulk of France's engineering elite — who prefers to remain anonymous. When he agreed to sign the Appeal, he sent us a note. In it he gives his reasons why, contrary to what we suggested, an accident at Creys-Malville is not improbable but *inevitable.*

One must remember that no one has ever built a 1300 MW breeder reactor before. The only experience that France has of a breeder reactor is a 250MW prototype — the Phenix — which has been operating not altogether successfully for the last five years at Marcoule. The 'Super-Phenix' will only work if we can assume that the scaling up of the Phenix by a factor of five will not give rise to any unexpected problems.

'The Super-Phenix', the politician informed us in his note, 'will have a plutonium core containing 4,600 tons of molten sodium of which 3,200 tons, the primary circuit, will be highly radioactive (with a high content of Na22 Na24) and 1200 tons — the secondary circuit, will be in contact with the pipes of the water circuit in the steam generators.'

Sodium burns spontaneously when in contact with water creating a fire that can be extinguished only with difficulty. To prevent such fires, water and sodium must be kept apart in the heat exchanger and that separation depends on the integrity of the piping carrying the two circuits. Yet such pipes are prone to cracking, especially when transporting corrosive sodium at high temperatures. Moreover cracks have already appeared in the water-steam heat exchangers of the Fessenheim Light Water Reactor. In fact each of the four steam generators of the Super-Phenix reactor under construction contains some 3000 welds. These welds must remain good throughout the operation of the reactor if leakages of hot sodium into water are to be avoided.

'It is thus inevitable' says our contact, 'that sooner or later the secondary circuit will burn, leading to a fire in the primary circuit. When as a result of the heat generated by the combustion of 4,600 tons of sodium, all the safety devices protecting the reactor core will be destroyed. Even in the absence of a nuclear explosion, a cloud containing twelve to fifteen thousand tons of radioactive sodium carbonate and bicarbonate enriched by several hundred kilos of plutonium oxide dust, would contaminate tens of thousands of square kilometres, causing the death, over a shorter or longer period, of hundreds of thousands of people.'

At the conference organised by L'ASPEA (Swiss Association for Atomic Energy) and FORATOM — Association of European Atomic Forums — which took place at Lucerne in Switzerland on the 14-17th October 1979 to discuss the fast breeder reactor and Europe, Soviet experts including L.A.Kochetkov, member of the State Committee for Atomic Energy of the USSR, described publicly for the first time the lessons to be drawn from the Soviet Union's experience with experimental breeder reactors. They admitted that in all their experimental breeder reactors the sodium in their steam generators had at one time or another caught fire. It is for this reason that the Soviet authorities had decided not to build commercial plants before the year 2010.

*Professor Ivo Rens*

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# Geneva Appeal

**An Appeal addressed from Geneva by members of the academic community to the political representatives of all european countries and all candidates for the European Parliament, so as to provoke a wide-ranging public discussion and to bring about a vote by the populations concerned on the alternatives to the fast-breeder reactor at Creys-Malville and the Plutonium Society.**

**Geneva Appeal Association**

**Case postale 89, 1212 GRAND-LANCY 1 (Geneva, Switzerland) C.C.P.12-18 441 Genève. Telex 27 160 PJPC CH.**

# The Chink in the Nuclear Armour.

**by Nicholas Hildyard and Peter Bunyard**

Every year, more than 1500 tons of spent reactor fuel, containing some six hundred million curies of highly radioactive fission products, are transported from Britain's nuclear power stations to Windscale for reprocessing. Until recently the public has hardly concerned itself about the possible hazards involved in transporting this waste: moreover it has taken on trust reassurances from the authorities that the waste is adequately protected. Dr Charles Wakstein, an American engineer now resident in Britain and a witness at the Windscale Inquiry, is however extremely concerned. He describes the flasks in which the waste is contained as "iodine free reactors, unguarded and mobile" and points out that some 9 tons a week of spent fuel (from the Dungeness, Sizewell and Bradwell reactors) pass through the most densely populated parts of London along some of the busiest rail routes. What would happen, he asks, if there was a derailment? or, more serious still, if the flasks were subjected to an intense fire after a collision with an oil or petrol tanker train?

When filled to capacity, each flask contains 200 to 300 irradiated fuel-rods, generating some 12 kilowatts of heat through radioactive decay. The rods, nestling in a 'skip' within the flask, are immersed in water which acts as a coolant, the heat being dissipated to the outside atmosphere by means of specially designed 'fins' on the outer wall of the flask. The flasks have no lead shielding and even with their 14.5 inch-thick steel walls, the gamma radiation dose at one metre from the flask is typically 1 millirem an hour. The permitted dose rate is 10 millirems an hour at two metres from the flask. The surface dose rate, mainly beta radiation, from incomplete decontamination, is allowed to reach 200 millirems an hour, which over 24 hours would give a whole-body dose equivalent to the maximum permissible dose over a whole year to radiation workers.

According to the CEGB, the steel walls are capable of withstanding all conceivable accidents involving rail or road transport. The CEGB have carried out collision tests at 30 miles per hour and claim that American experiments prove that a flask could withstand high-speed collisions. Wakstein disputes that claim, pointing out that the American tests were conducted with cylindrical flasks, whereas those used by the CEGB are cubic. Moreover, the CEGB is

Homer Sykes

Dr. Wakstein

now collaborating with British Rail on new designs of flasks capable of withstanding 60 m.p.h. direct crashes with a tunnel face. "Those new designs would hardly be in hand if there was no need for them," remarks Wakstein, adding that the CEGB's insistence that the flasks can withstand a 60 m.p.h. crash evades the issue of a collision involving a passenger train travelling at more than 100 m.p.h.

Each flask contains all the wastes from a reactor, minus short-lived fission products such as radio-iodine, which have already decayed by the time they are transported. Clearly if there were to be an accident which breached the flask and released the fission products, it would result in numerous deaths and make the area around the accident uninhabitable for several generations.

How great is the risk of such an accident? Wakstein claims that a flask could be breached by the impact of a major collision. If that were to happen, the water in the flask might drain away, leaving the spent fuel without its coolant. In 1968, the CEGB reckoned that in such an event, the temperature within the flask would rise to 550°C within nine hours - barely 100°C lower than the melting point of the Magnox cladding. Studies from the USA indicate that if the cooling water is lost, 2.5 per cent of the radioactive caesium in the fuel rods might escape along with other fission products. Such a release would necessitate evacuation of the population downwind from the accident.

The situation could be worse should a fuel flask become involved in a major fire when as much as ten per cent of the caesium could be released. Wakstein argues that the 30 minute fire tests carried out on the flasks by the CEGB are 'inadequate', inasmuch as there have been fires involving British Rail goods-trains which have lasted as long as four hours. Indeed he has calculated that within one hour and twenty minutes, the fuel would reach its melting point. Even if the flask remained intact, superheated steam generated within the flask could blow the rubber seals and stretch the bolts clamping the flask's lid. If the flask ruptured then the spent fuel could ignite and bring about a major release of some forty fission products including plutonium.

Wakstein fears that the flasks offer an easy, terrifyingly effective target for terrorists - much easier, in fact, than a reactor or any other nuclear installation. He himself worked on the design of a'super-bazooka' in the early 1950s which was capable of piercing some 12 inches of armour-plated steel, far tougher than the mild steel used in the fuel flasks. Today's anti-tank rockets are even more effective. Last November, the ease with which a terrorist might attack a flask was demonstrated when members of the Freedom of Information Campaign quite openly carried a film-prop bazooka onto the platform of a station where a flask was in a siding. No-one questioned them or stopped them pointing the bazooka at the flask. Two well-placed rockets would result in a loss of cooling water and the certainty of a major radiation release. When Wakstein informed the then Home Secretary, Merlyn Rees, about the threat from terrorism, he was told that it was of no concern of the Home Office and that he should contact the Department of Energy.

Following the Windscale Inquiry, Wakstein approached Gordon Thompson of the Political Ecology Research Group (PERG) and asked him to carry out a computer analysis on the number of deaths that would result from a major flask accident. To run the programme, PERG

needed to know a possible site for such an accident. Lacking the information, Wakstein telephoned British Rail and asked openly for the routes of nuclear flasks around London. He was told that the trains did not bypass London and that those from the East entered London at Stratford, whilst those from the South came in via Clapham Junction, both making their way along goods-only lines to Willesden Yards. When Wakstein put his questions in writing to British Rail the answer came back that the routes were classified information.

Knowing the routes, he then obtained the population density data for the areas of a possible accident. PERG ran a computer model and estimated that a 100 per cent release of caesium alone would result in 70 early deaths and 7,200 long-term cancers. Using that data and the estimated dose rates, Wakstein then calculated the amount of time that the area affected by the accident would need to be evacuated. In the US, evacuation is called for if a nuclear accident results in caesium levels over 100 microcuries per square metre, which would give an initial radiation dose in excess of the 1 millirem per hour which the US authorities deem the maximum permissible level for human habitation. That dose would be nearly 100 times natural background radiation levels and would give rise to serious genetic and somatic disorders. As Wakstein puts it, "To remain in the area would be like living near an x-ray machine that's switched on twenty-four hours a day." In an urban area, the radiation levels would persist for several hundred years in accordance with the thirty year half-life of caesium. In the country, those levels would have to drop to one fifth of one millirem per hour before the authorities would deem food grown there fit for human consumption, according to present radiation standards.

Wakstein has calculated that if an accident occurred in London (Earls Court, for example, through which nuclear flasks are regularly routed) some 80,000 people would have to be evacuated for up to 125 years if most of the long-term cancers were to be avoided; and that with only 10 per cent of the caesium in the flask being released. Because the caesium plume takes time to come to earth, the area worst affected by the disaster could be several miles from the accident.


A theatrical bazooka is aimed at one of the flasks containing irradiated fuel rods to demonstrate the ease with which a terrorist might attack. These containers pass through densely populated areas of London by rail.

Freedom of Information Campaign

What would the authorities do in the event of an accident? Would they evacuate? Wakstein has good evidence that the authorities have no plans for mass evacuation: in the event of a serious nuclear incident (be it a reactor, reprocessing plant or a flask), their main concern would be to evacuate for long enough to avoid immediate Hiroshima-type symptoms among the population. Significantly the authorities evaluate the consequences of a nuclear accident in terms of the additional risk for the individual to develop cancer, little mention is made of the overall consequences of the number of people who would die from a major accident. If, for example, someone is told that the additional individual risk of dying as a result of an accident is only 0.1 per cent, he is unlikely to be unduly concerned considering that he already faces a 1 in 5 chance of dying of cancer. But tell him that 9000 people within a 500 kilometre radius of a major accident will die and the statistics take on a different perspective. Moreover the 0.1 per cent risk figure accepted by the authorities is estimated on the assumption of a dose response which is now under serious challenge. Already additional birth defects are being registered downwind of Three Mile Island where dose rates were considered negligible.

At a secret meeting, held in January for local Environmental Health Officers, Councillors and London MPs, the CEGB claimed that the procedure for evacuation in the event of a flask accident were the same as those for any other disaster involving radiation and that the emergency services were well-prepared. Yet various officials at the meeting stated that they did not know what the emergency plans entailed. The CEGB also claimed that flask accidents were covered by the NAIR scheme (National Arrangements for Incidents involving Radioactivity). In fact the official accident manual issued to railway workers states quite specifically that NAIR assistance is *not* to be called for in the event of a flask accident. The instructions are clear: the only people to be contacted are CEGB safety officers. Incredibly, the task of assessing whether even their help is needed is left to the train crew. Could it be that the nuclear authorities do not wish to involve outsiders - particularly outside radiation experts - in assessing the extent of an accident, let alone what action should be taken to minimise its effects?

Clearly the transport of Magnox fuel presents serious problems. Once a fast breeder programme gets underway, spent fuel will have to be transported around the countryside, and the consequences of a major accident could be many times worse. In place of water, the coolant needs to be sodium or a sodium-potassium alloy. Above 140°C that coolant ignites spontaneously with air. It also reacts explosively with water. As for the fuel elements they contain a far higher inventory of fission products and large quantities of plutonium. Transporting that waste on any scale could well prove a sizeable chink in the nuclear industry's armour.

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# Ethnocracy: The Lesson from Africa

by
**Edward Goldsmith**


U. Beier

Carved head in a Shango shrine in Nigeria

The general election in Zimbabwe has now taken place. Lord Soames has accomplished his very delicate mission with great courage and considerable skill. Mrs Thatcher's government has succeeded in finding a solution to a problem that has defied many previous governments. It is undoubtedly a political triumph, but will it bring to power a stable government and a lasting peace? The answer is almost certainly no. It is not because of any ideological differences between the various political groupings in Zimbabwe. It is because Zimbabwe is not a nation, but at least two nations: Mashonaland in the North East, which was settled in antiquity by a Bantu speaking people known as the Shonas, and Matabeleland, which was settled by the Ndebele, and offshoot of the Zulus who fled there from the armies of the great conqueror, King Chaka.

The two nations were independent until we occupied Matabeleland in 1888, having obtained a concession from its king, Lobengula, to exploit the country's mineral potential.

Already at that time, the Ndebele and the Shona were bitter enemies, indeed it was on the pretext of protecting the Shona from constant Ndebele raids that, in 1890 we first occupied Mashonaland. These two nations are still very different from each other, as different as France is from Germany, and it is difficult to see how they can be merged with impunity into a centralised nation state on the western model.

That these tribal groups have remained separate is clear from the nature of the movements that have sprung up to combat white domination, though we like to explain the rivalry between these movements in purely political and ideological terms it is, in reality, based on ethnic differences. The Zimbabwe Peoples Union (ZAPU) being largely composed of Shona tribesmen while the membership of the Zimbabwe National Union (ZANU) is largely Ndebele. These two nations moreover are divided into distinct sub-groups which also have their political arms. Thus Mr Chickerema's Zimbabwe Democratic Party is based on the Zezura tribe while Bishop Muzorewa's UANC is largely based on the Manyika tribe — both of which are sections of the Shona.

Originally, the two main tribes tried to join forces in their opposition to the colonial regime. Both were represented in the National Democratic Party (NDP) founded in 1960 with Joshua Nkomo as president, but it only lasted two years and efforts to get the two tribal groups to form a joint political movement have since all failed.

Joshua Nkomo though undoubtedly a very powerful figure and father of nationalism in Zimbabwe Rhodesia, was unlikely to win the election because he is a Karanga, i.e. a member of the tribe that originally inhabited Mashonaland before the Ndebele invasion. They are now inter-married with the Ndebele, (in fact, Joshua Nkomo's wife is a member of the Ndebele royal family) and have become closely associated with this tribe. Together the Ndebele and Karanga make up only 19 per cent of the population of Zimbabwe. It must follow that if Zimbabwe is considered to be a single political unit then in the long run in any case it can only be governed by the Shona people who make up 77 per cent of the population.

Successive Shona prime ministers are likely to assure everybody that, in the democratic state of Zimbabwe, everybody is equal, regardless of race, culture or creed. But in reality things will be different. The Ndebele together with their Karanga allies will be reduced to the status of a subject people. Rather than having freed themselves of colonial domination they will simply have acquired new masters, masters too that are likely to be

tougher in dealing with their new subjects — their old enemies the Ndebele — than were their European predecessors.

Nor will it be long before the Ndebele try to break away to form their own nation, just as did the Ibos in Nigeria and the South Sudanese in the Sudan, but they will do so in the face of world public opinion. Everywhere, politicians will vie with each other in providing the "legitimate" government with money and arms to fight the "rebels" or "terrorists" as the Ndebele will undoubtedly be referred to. The latter will thereby be forced to seek aid from Cuba, Russia and the other enemies of the West, in this way internationalising the conflict as, in similar situations, has invariably happened in the past.

African tribalism is rarely discussed in European circles, almost never in political circles. Since it is unquestionably the determinant factor in African politics it seems reasonable to ask why it is ignored in this way. One reason is that it is seen as a relic of barbarity. To suggest that tribal groupings still exist is to brand a country as backward and under-developed. It is often regarded as insulting to question an African politician on tribal matters. And there are other reasons. One is that it is difficult for us to have political and economic dealings with tribal societies who tend to live outside the orbit of the industrial system — who have neither formal or economic or political institutions. If such societies are to take part in the political and economic life of the world community then they must be organised like us into nation states with politicians, bureaucrats, large cities and a formal economy.

We are not the only ones to turn a blind eye to tribal realities. The African elite is even more hostile to it — for it is composed of people who have little status within traditional tribal hierarchies. Most of them are not chiefs but commoners and if they are in power it is because they were educated in our western universities and have thereby become capable of competing successfully in the totally new conditions created in Africa as a result of western type development. It is therefore in their interest to perpetuate these conditions, indeed to accelerate the process of development and social transformation, for the faster it occurs, the faster must be the transfer of power from the heads of the traditional social groupings to those of the new economic and bureaucratic structures which they control. The colonial regimes as Nigerian Ecologist Jimoh Omo Fadaka notes were, "on the whole hostile to tribalism, if only for the very good reason that it represented a potentially rival structure of power to their own." This is truer still of the new political regimes in Africa to whose precarious authority the tribes present a very much greater threat. Almost every politician's undivided following is still derived from the membership of the tribe to which he belongs and whose identity he has not yet succeeded in destroying.

**South West Africa-Namibia**

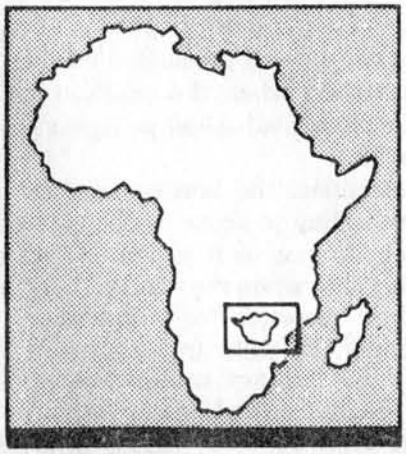
In the meantime, Lord Carrington, intoxicated with success, now seeks other worlds to conquer. If he can solve the apparently insoluble problems of Zimbabwe Rhodesia then surely he will be able to do likewise with those of South West Africa-Namibia. But his efforts are likely to be equally fruitless, for if Zimbabwe Rhodesia is an artificial creation, South West Africa-Namibia is even more so. This vast territory is inhabited by many different nations who only have in common with each other a long tradition of mutual hostility. Among these is that of the Ovambos who make up 44 per cent of the population. They live in the Northern area (Ovamboland) and are separated from their brothers in South Angola by a purely arbitrary frontier that once marked the border between Portuguese and South African influence.

The next most populous nation is that of the Hereros, a Bantu people who migrated to that part of the world some five hundred years ago. The third is that of the Namas, a branch of the Hottentot, who are the Hereros' traditional enemies. A fourth nation is that of the Berg Damaras, who for centuries were the slaves of the Nama while other small ethnic groups include the almost self-governing Rehebothers who are of mixed Boer and Nama blood and the Bushmen of the Kalahari.

The gulf that separates these nations is reflected in the tribal basis of the political movements set up to oppose the colonial regime. Thus the South West Africa Peoples' Organisation (SWAPO), traces its origin to the Ovamboland Peoples Organisation and needless to say was set up by Ovambos.

The South West Africa National Union (SWANU) was set up by the Hereros. These are the two main

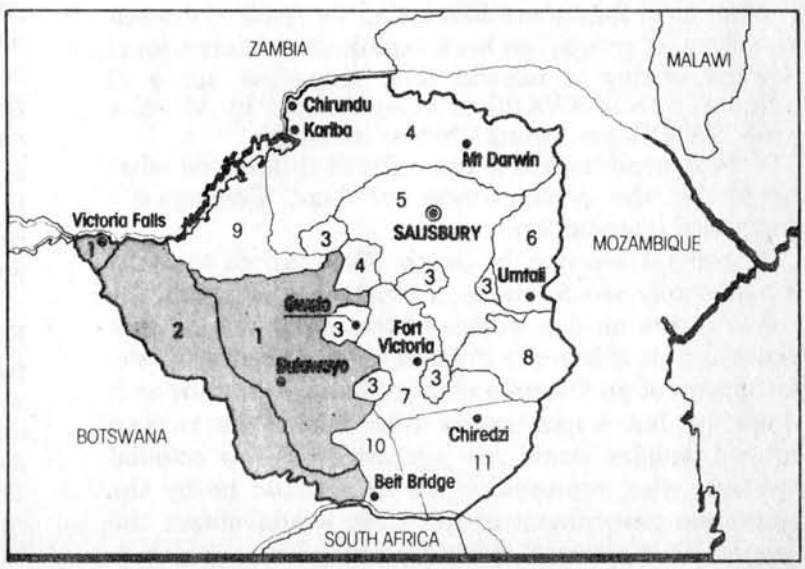
## The Division of Tribes and Territories in Rhodesia



| NDEBELE ORIENTATED TRIBES | % of population |
|---|---|
| 1. Ndebele | 14% |
| 2. Kalanga | 5% |

| SHONA ORIENTATED TRIBES | |
|---|---|
| 3. Rozwi | 9% |
| 4. Korekore | 12% |
| 5. Zezuru | 18% |
| 6. Manyika | 13% |
| 7. Karanga | 22% |
| 8. Nadau | 3% |

| OTHERS | |
|---|---|
| 9. Tonga | 2% |
| 10. Venda | 1% |
| 11. Shangaan | 1% |



political groups, the only ones we tend to hear about in the Western press: but there are others. Indeed the Nama have also set up their political movement: the South West Africa United National Independent Organisation (SWANIO). The Berg Damaras have set up theirs: the South West Africa Democratic Union (SWADU), so have the Coloured who call theirs the South West Africa Coloured Organisation (SWACO), and the Rehebothers — which is known as the Rehoboth Burgers Association.

Just as in Zimbabwe Rhodesia, all attempts to unite these groups into a single anti-colonialist movement have failed. Thus in 1963, an attempt was made to merge SWAPO and SWANU into a single organisation to be called the South West African National Liberation Front (SWANLIF). It came to nothing, nor were Kerina's National Unity Democratic Organisation (NUDO) and the South West Africa National United Front (SWANUF) any more successful.

As in Zimbabwe Rhodesia, political leaders in South West Africa-Namibia refuse to admit that their 'parties' are tribally based. They are unanimous in regarding tribalism as an evil that must be stamped out at all costs. Attempts to accommodate tribal differences in South West Africa-Namibia are seen by Kerina and other Ovambo politicians as part of South African backed conspiracy to 'balkanize' this 'country', so as to weaken it and prevent it from developing into a modern industrial state.

The reason for this is partly at least that 'separate development' has been official policy for a long time in South West Africa and since December 1978 the country has been partly run by a National Assembly that is organised on a federal basis and in which the different ethnic groups are represented. But the land allocated to the African groups is totally insufficient, most of it, and in particular that which is most suitable for agriculture, has been reserved for the European settlers, mainly Boers and Germans, even though they only make up 10 per cent of the population. As a result, rural whites have forty times more land per head than rural blacks and far better land at that. Quite obviously this is not a satisfactory basis for a stable federation and, at the same time, it has helped to discredit the essential principles of ethnic autonomy and federalism, as well as strengthened the hand of politicians who wish to establish in South West Africa-Namibia a monolithic state on the western model.

Also, as in Zimbabwe Rhodesia, the rivalry between the different groups has been exploited by international powers seeking to expand their respective zones of influence. Thus SWAPO is being backed by Moscow while SWANU has strong Chinese leanings.

In these conditions it is not difficult to imagine what would be the consequences of Lord Carrington's suggested intervention.

A general election in South West Africa-Namibia would simply be a formality, a ritual for legitimising the power of the most populous of the many nations that make up this arbitrarily defined area, a licence for the setting up of an Ovambo empire. In such conditions it would be but a question of time before the various subject peoples would rise against their new colonial masters, who, represented, as they would be by the legitimate government of the land, would obtain the support of Western Democratic countries to maintain the status quo.

If this can be predicted with such confidence, it is that it has already happened so many times before, always with the same tragic consequences. If we take for instance the four most murderous wars that have rent Africa in the last twenty years:- those that occurred in Nigeria, the Sudan, Ethiopia and Angola, it can be shown that each could have been avoided if the political boundaries inherited from the departing European colonial powers had corresponded more faithfully with those that separate the nations that inhabit these territories. Let us see why this was so.

**Nigeria**

Nigeria, as Omo Fadaka points out, was once heralded as "the bastion of Parliamentary democracy in Africa" and "Africa's showpiece". This was sheer wishful thinking. Nigeria is as artificial a country as Zimbabwe Rhodesia and South West Africa-Namibia. The northern area is lived in by the Moslem Hausa Fulani people who are organised into a large number of small feudal states and by tribal peoples such as the Tivs, the Igalas and the Idomas who practice their own tribal religions. The Eastern region is largely inhabited by the Christian Ibos who are organised into semi-autonomous village groups. In the west are the Yorubas who are also Christians, and in the Mid West live the Edo speaking people, the Ishawas, the Agos, the Binis, the latter being organised into a highly centralised kingdon run by the semi-divine Oba of Benin.

These different peoples have little in common with each other. Indeed as Chief Awalowo put it, Nigeria, is but "a mere geographical expression at best an agglomeration of tribal nations. There is as much difference between them as there is between Germans, Russians and Turks." Some of these nations are very populous. There are at least 20 million Hausa Fulani, 8 million Ibos, 10 million Yorubas, more than there are Swedes, Danes, Norwegians or Finns. As elsewhere in Africa — ethnic differences in Nigeria, are reflected in the political parties that were set up to combat the colonial powers. The Northern Peoples Congress for instance was predominantly Hausa Fulani while the National Council of Nigerian Citizens was largely Ibo. Under these conditions the course of events after independence was fairly predictable.

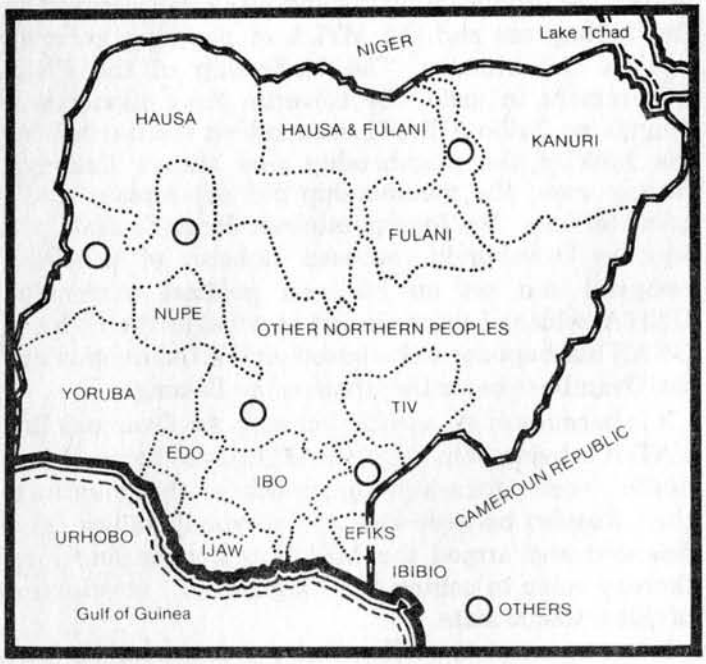
As Jimoh Omo Fadaka points out, parliamentary government is only possible if the party that looses an election is willing to accept the result and thereby accept the legitimacy of the government that has been returned to power. This it will only do, if it regards the survival of the State as being more important than the achievement of its own political goals, a condition that is unlikely to be satisfied when the political parties represent little more than rival tribal groupings — as was the case in Nigeria.

Thus, after the elections, the northerners, as Omo Fadaka writes "were willing to abide by the laws of the parliamentary system so long as it appeared that they would win the election, but when they found their position threatened, they resorted to intimidation and denied their opponents the right to hold meetings". The result was an Ibo military coup followed by a counter coup that brought General Gowan to power and led to the massacre of about 30,000 Ibos in the North.

This was the prelude to a particularly murderous war which caused the death of well over a million people, and which was rapidly internationalised; the Russians, British, and Egyptians providing arms to the government forces and the French, Czechs and Chinese equipping the Ibos.

Up to a point, the Nigerians seem belatedly to have learned their lesson. The territory has now been divided into 19 states corresponding reasonably well to the main ethnic divisions. They all have equal representation in the Senate regardless of their size. It remains to be seen whether this arrangement is sufficient to accommodate the vast cultural differences that separate the different nations that make up the Nigerian Nation state.

## Ethnic divisions in Nigeria




### The Sudan

In 1953, the Egyptian government, in conjunction with North Sudanese political parties and the British Government, set up a new independent country to be called The Sudan. Like the other artificial countries we have already considered, its chances of success were from the start negligible. It is divided up into two very different regions, the North and the South.

The North is largely desert, the South until recently was largely forests and marshes. The North is inhabited by light brown skinned Hamito-Semitic peoples who regard themselves as Arabs, the South by various black skinned tribal peoples — Nilotics such as the Dinka, the Shilluk and the Anuak — Nilo-Hamitics such as the Murle, the Didinga and the Boya and Sudanic people such as the Azande, the Kreish and the Bongo.

In addition, the North has been in contact with the Mediterranean for thousands of years and is Mediterranean in culture and aspirations, whereas the South has had, until recently, but few contacts with the outside world and is African through and through. What is more, all these differences are compounded by the fact that the Northerners have embraced the Moslem faith while the Southern tribes either practice their own tribal religions or have been converted to Christianity.

In other words, climatically, ecologically, historically, racially, culturally and religiously, North and South are poles apart. In such conditions it was totally irresponsible to create a centralised Sudanese state. Once it was created, events were fairly predictable. In the Parliament set up in 1953, the Southerners obtained but a quarter of the seats. They were thereby condemned to be governed by the Northern Arabs who had been made their legitimate masters.

Of course the Government did everything it could to mask inconvenient ethnic realities. Major Sahal Salim the famous "dancing major", an Egyptian Government Minster at the time, assured the world that, whatever their racial and religious differences, the peoples of the Sudan were one — which of course, was, and is arrant nonsense.

Britain had in effect helped to create precisely those conditions that most favoured oppression, revolution and war. Nor has it taken long for this war to break out. In 1955 there were riots at Nwara leading to the death of about twenty people. In 1963, war broke out in earnest. It was mainly a guerilla war but it was a particularly nasty one. Like the war in Nigeria and elsewhere it was quickly internationalised with the Russians arming the North Sudanese and providing them with an estimated 700 military advisers, while other countries, Israel in particular, armed the South.

Peace appears to have returned once more to this area, but only the most starry-eyed optimist can suppose that it can be maintained for long.

### Eritrea and Ethiopia

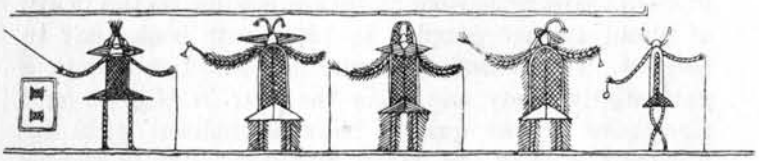
The present war between Ethiopia and Eritrea which has now gone on for ten years, provides a further illustration of the same thesis. Eritrea is an artificial country created by the Italians in 1890. The territory is a small one, a little smaller than England. Ecologically it is made up of two distinct areas, the central mountainous area containing the capital, Asmara, and the lowland area bordering the Red Sea. The former was once part of the Christian kingdom of the Tigre, and its inhabitants are ethnically Tigreans, and like their brothers, who have been incorporated into the Ethiopian empire, they have embraced Christianity. The latter area is inhabited largely by Sudanese and Danakils and also by some Tigreans. They have been governed successively by Turks, Egyptians and the Sudanese followers of the Mahdi. They speak Arabic and have embraced Islam. So once again we are faced with a totally artificial political unit that can only be maintained by force.

After the war, a Four Power Commission consisting of the Soviet Union, Britain, France and the USA, decided to federate it with Ethiopia. They could not have taken a more irresponsible decision, firstly, because an artificial country such as Eritrea could never be a sound building block for a satisfactory federation, secondly, because Ethiopia is an artificial creation, being in effect the empire of the Amharas, over the Gallas in the South, the Somalis in the East, the Tigreans in the North, the Danakils along the Red Sea plains and a host of small tribes that fall into none of these different

categories. In addition, one cannot advantageously federate so small a political unit as Eritrea with so massive a state as Ethiopia.

Predictably, the federation was of short duration. Ethiopia took over more and more power, and by 1955, the federation existed in name only. A revolt was inevitable. It started among the Moslems of Western Eritrea who set up the Eritrean Liberation Movement (ELF). This quickly split up into two rival factions which, though we are never told it, represent the two separate nations that inhabit that territory.

The war is likely to drag on for a long time. If the Eritreans are ever subdued, it can be predicted, with confidence, that they will rise again when the opportunity presents itself. Were they eventually to obtain their independence their problems would still not be over. The two nations that inhabit the Eritrean territory would soon be in conflict and this conflict would not be resolved until the territory were split up into its natural ecological and ethnic regions.



Ovimbundu designs

**Angola**

Angola is of course another completely artificial creation, though a very old one since the Portuguese set it up as a Colony as far back as the sixteenth century. The largest of the many nations that inhabit this territory is that of the Ovimbundu with a population of 1.5 million people. They live in the central highlands and have been Christians for a very long time. The second largest is that of the Kimbundu with a population of about 1.2 million centred around Luanda, the capital. The third biggest is that of the Bakongo, the heirs of the ancient kingdom of the Congo that was broken up in the 18th century. Their territory has been carved up by the colonial powers, so that some of the Bakongo people are now citizens of Angola, others of Zaire and still others of Congo Brazzaville. Another important nation inhabiting the Angolan territory is that of the Chokwe-Lunda, whose ancestors created the Lunda Empire. They live in North East Angola astride the border with Katanga. The Southern part of the territory is inhabited by the Cuanhama tribes which are part of the Ovambo nation that, as we have seen, spreads across the border of South West Africa-Namibia.

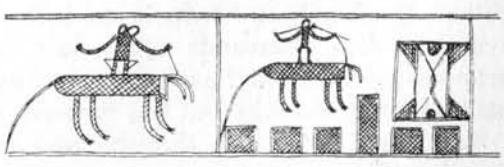
Ever since the colony of Angola was first set up, these various nations have constantly revolted against their colonial masters. War was a natural state of things in Angola from the very start. The current war, however, began in 1961. It was started by the Movimento Popular de Libertacao de Angola (MPLA) in the Luanda area and the Uniao das Populacoes de Angola (UPA) in the North. The former, which has now come to power, traces its descent to the Partido da Luta dos Africanos de Angola (PLUA), which in turn grew out of the Partido Communista de Angola (PCA). The MPLA, as opposed to most of the political movements we have considered so far, is not a tribal grouping but an urban movement consisting of European separatists, Mestico intellectuals and a few urbanised and westernised Africans, and it is for this reason that it has always failed, and always will fail, to obtain the support of the tribes which make up the vast majority of the inhabitants of Angola. The other political movements in Angola are on the other hand purely tribal. The Frente Nacional de Libertacao de Angola (FNLA) for instance, traces its descent to the Uniao das Populacoes do Norte de Angola (UPNA), which was originally set up with the goal of restoring the old kingdom of the Congo, and which was later transformed into a theoretically multi-tribal movement, the Uniao das Populacoes de Angola by Holden Roberto and merged with the Partido Democractico Angolan (PDA) which was based on the Zombo tribe of the Bakongo.

The FNLA's multi tribal facade was always very thin. The movement was from the first, hostile to the settlers and to the urbanised blacks and was often accused by the Portuguese and the MPLA of planning genocide against the Mulatos. The leadership of the FNLA government in exile, the Governo Revolutionario de Angola no Exilio (GRAE), was indeed multi-tribal but the bulk of the membership was always Bakongo. In any case, the membership did not remain multi-tribal for long. The foreign minister Jonas Savimbi who was an Ovimbundu, accused Roberto of tribalism, resigned and set up his own political movement, UNITA, which of course is just as tribal as the FNLA or GRAE but happens to be based on the Ovimbundu and the Ovambo tribes rather than on the Bakongo.

It is because of its association with the Ovambos that UNITA is being helped by SWAPO across the border in South West Africa-Namibia, much to the chagrin of their Russian backers who, as everybody knows, have financed and armed the MPLA in Luanda and have thereby come to control the "legitimate" government of this artificial state.

It is important to realise that the countries we have considered are in no way exceptional, what I have said about them could also be said of the newly independent countries of Africa and of Asia for that matter. This means that both these continents are condemned to be ravaged by increasingly murderous wars until such time as we accept the essential principle that tribes or nations should be allowed to govern themselves, rather than be subjected to the arbitrary rule of the larger tribes or nations that dominate the artificial states that we have helped set up to satisfy what are nothing more than short-term political and economic requirements.

That we should not have accepted this essential principle is all the more surprising in view of the recent European experience which is much more similar to the African one than we would like to admit.



Ovimbundu designs

Indeed, practically all the European states of today are artificial creations made up of nations whose separate identity is largely ignored. For a long time, European people, preoccupied as they have been with purely economic considerations, have been willing to see their ethnic identity submerged in a vast anonymous mass society and to be little more than "faces in the crowd". Increasingly, today they want to be part of a real society in whose cultural life and in whose government they can actively participate. Not surprisingly, autonomist movements are gaining strength in almost every European state.

In Spain, Catalan nationalists have been active for decades, and today the Basques are even more so. Their action has recently forced the central government to provide the nations that inhabit the Spanish territory with a measure of self government that is undoubtedly a prelude to still greater political decentralisation.

In France, autonomist movements are increasingly active among the Corsicans and the Bretons, and in Britain, we are witnessing the development of powerful nationalist movements in Scotland and Wales and even in Cornwall.

In Northern Ireland, the hostility between two different ethnic groups, the indigenous Irish on the one hand and the descendants of the 17th century Scots immigrants on the other, has already led to the deaths of thousands of people. The ethnic basis of this crisis is never even mentioned — instead it is passed off as a purely religious dispute between Catholics and Protestants. Indeed, the reason is that in the present ideological climate it is not politically expedient that these differences be accommodated, so instead, they are ignored, and it is on the altar of this political expediency that young English soldiers and innocent Irish civilians are sacrificed almost daily.

National unity, we persuade ourselves, must everywhere be preserved at all costs. Breaking up countries into smaller areas, we regard as totally impractical. To begin with, these areas would not be able to defend themselves against an external aggressor. This of course is not necessarily true. They could associate themselves to form a confederation as did the Swiss communes who thereby succeeded in preserving their independence for centuries, far more successfully than did many of their larger neighbours. Today, if Pakistan is to defend itself against the new Russian threat from Afghanistan, its most sensible course is to grant the Baluchis, whose territory the Russians quite clearly covet since it borders the Indian Ocean, that measure of autonomy that they demand. If they do not, then the Baluchis might well cooperate with the Russians against their Punjabi overlords. If they do, then the Baluchis would undoubtedly fight to preserve their newly acquired autonomy, for as Mr. Gladstone said, "there is no barrier like the breasts of free men."

Another argument for preserving the present frontiers of Europe is that the natural regions of Europe would not constitute viable economic units. This argument is totally without foundation. There is no reason to suppose that the inhabitants of China, America or the Soviet Union are better off than those of Iceland, Switzerland, Denmark or Luxembourg. Indeed the opposite seems to be true, and the argument for breaking Europe down into its natural regions as Leopold Kohr pointed out so convincingly in his classic: *The Breakdown of Nations*, are overwhelming.

Significantly enough, Federal Germany was divided up by the allies into eleven "Lander" each with a high degree of local autonomy, with the avowed intention of weakening her. Needless to say, this measure had the opposite effect, indeed, as Denis de Rougemont, the eminent Swiss writer and advocate of Federalism points out, "this federal and regional form of government goes a long way towards explaining the political, economic and social recovery of Germany."

This is even truer of Switzerland, which, again as Denis de Rougemont notes, has "for six or seven centuries provided the image of an exemplary federation of historic regions which find in their union — strictly limited to certain public functions — the guarantee of their autonomy."

Switzerland is indeed socially and politically the most successful country in Europe. It is a loose association of communes or "Gemeinde", that during the Middle Ages joined together voluntarily in order to better protect themselves against feudal domination.

These communes have much in common with African tribal groups. Like them they are governed by an open assembly of the menfolk. The communal land is held in common by its members. The communes are social not just administrative units, a man remains a member of his Burgergemeinde regardless of where he decides to settle, and it is to his Burgergemeinde and not to any State bureaucracy that he must turn when in need. What is more, to become a Swiss citizen he must first be accepted as a citizen of a commune and of a canton, which means that the Swiss state is not composed of any anonymous mass of isolated individuals, as are most industrial countries today, but of semi-autonomous cantons themselves made up of semi-autonomous communes, themselves composed of families and individuals.

One cannot stress too strongly the fact that these communes and cantons joined together voluntarily to form the Swiss Confederation. They participate actively in this federation on an equal footing. They are not dominated by any one group and if, in certain instances, they feel that they are, then they can break away and form their own canton, just as the French speaking people of the Jura recently did, so as to avoid being dominated by the German speaking people of the canton of Berne.

It is only in these conditions that larger, stable political units can be built up. "No one national group" Omo Fadaka writes, "cherishes the idea of being ruled by the other. What they desire most is to find a formula for living together in a poly-ethnic society. The only way to do this is for the different national groups to be allowed to develop separately without fear of political domination of one section by the other. There is no way of removing this fear other than by granting them complete political autonomy. Once this fear is removed, full economic, social and cultural cooperation could well lead to that unity which has eluded the country so far."

In Europe, people are now slowly beginning to see the light. In Belgium for instance, a new project is being studied to divide the country into four regions, one Waloon, one Flemish, one German and one com-posed of the ethnically mixed population of Brussels. What is more, much of the power would be delegated to sub-regions made up of associated communes.

The Council of Europe too is beginning to show greater interest in the concept of federalism. Recently, a meeting was held under its auspices to study the natural regions that cut across present state boundaries. A typical one is the 'Regio Basiliensis' which

includes Alsace, Baden and the Swiss Canton of Basle. The inhabitants of these areas are ethnically related, being descended from the Germanic tribe of the Allemani, and speak a similar German dialect. They have recently been made aware of their common identity by the threat to their biological survival posed by the nuclear industry that proposes to put up no fewer than sixteen nuclear power stations in their midst, six in the French section of this region, five in the Swiss and five in the German — a nation is indeed made by its enemies rather than by its friends.

Another such region, at present being studied by the Institut Universitaire d'Etudes Europeenes in Geneva, is the Lemano-Alpine region made up of much of French speaking Switzerland, the Franche Comte, Savoy, the Val d'Aosta and parts of the French departments of the Isere and of the Ain. Another is the Triestine region made up of the Friuli, Carinthia and Slovenia. In all, fifteen such regions have been identified, and it is hoped that they will slowly be allowed to become effective units for certain social and economic purposes at least. It is only by encouraging such developments, and by generally decentralising power from the governments running the artificial countries of Europe to those of the real nations that compose them. that stability and peace can be assured. In the meantime, it is very irresponsible to set up political structures in Africa and elsewhere in what was once our Colonial Empire, that do not reflect social realities, and whose eventual dismemberment into their natural regions is inevitable and, what is more, at the cost of a great deal of unnecessary human misery.

In Africa, some people are beginning to see the light. In Zimbabwe Rhodesia Chief Kaisa Ndiweni has founded the United National Federal Party which did unexpectedly well in the May 1979 elections. Chief Ndiweni has emphasised the totally artificial nature of the newly independent African countries and he fully realises that Rhodesia is no exception to the rule. His party is committed to dividing Rhodesia into two semi-autonomous regions, one for the Shona and the other for the Ndebele. The regions would be but loosely associated to form a federation, the federal government being responsible for defence and other functions that are best fulfilled at that level. Chief Ndiweni has obtained considerable support for this scheme from among the Ndebele people, but predictably, the majority of the Shona are against it. However, it is only if Chief Ndiweni's ideas are rapidly accepted by the majority of the people of Zimbabwe that it will be possible to prevent the chaos and bloodshed that otherwise lie in store.

*Benin carved casket lid*

## BRITAIN'S FIRST NUCLEAR WASTE INQUIRY?

Public Inquiries in Britain have recently come in for a lot of criticism, and several conservationist groups have expressed fears that the planning process is being by-passed by the Government's commitment to nuclear power. An inquiry is basically a democratic process, by which the public can have their say in developments affecting their own locality. Increasingly, however, many people believe that Britain's inquiry system makes a mockery of the democratic process. An inquiry which started in Ayr on February 19th looks like being one of the most farcical yet.

It is a Public Inquiry into the decision by Kyle and Carrick District Council (South-West Scotland) to refuse permission for test bores to examine the suitability of rock formations for the disposal of nuclear waste. The Council believe they are acting "in accordance with public feeling in their area". Opinion Polls conducted by *The Ayrshire Post* and *Dumfries and Galloway Standard* in 1978 showed that 80-90% of the population of South-West Scotland were opposed to test-bores.

The terms of the inquiry were announced on November 5th 1979, but objectors, already disillusioned after Windscale, have been incensed by Scottish Secretary of State, George Younger's insistence that the inquiry should be restricted to the specific application to test drill a number of sites and the siting of temporary dwellings at Mullwharchar in South Ayrshire.

Mr. Younger's decision means, in effect, the exclusion of discussion on nuclear waste disposal at the inquiry. He is keen to point out that any proposal to bury nuclear waste at Mullwharchar will have to be subject of a further planning application. The inquiry reporter has ruled 'out of order' two crucial points from Kyle and Carrick District Council's observations. These basically dealt with the implication of allowing test-drilling to take place for the possible future disposal of nuclear waste in the area.

The strength of public feeling is clear: they want no nuclear waste dumped in their hills and so there is little point carrying out any test drilling. The bore-holes will give no information about other sites; the data collected will only help the UKAEA decide on the suitability of Mullwharchar for the disposal of nuclear waste.

Professor I. Tolstoy, a geologist resident in Ayrshire, points out that there is no scientifically acceptable way of assessing the risks involved in high-level waste burial. Many of the world's foremost materials scientists, have cast doubt upon the vitrification process (the production of a 'stable' glass in which waste will be suspended or encapsulated). The integrity of the 'geological barrier' is another vital issue. Yet the inquiry reporter refused to postpone the inquiry until data on the recent earthquake centred on Carlisle was made available. Any earthquake of similar magnitude under Mullwharchar could introduce new fractures and flow paths for underground water.

It is widely believed that, because of the wide scope of 'The Official Secrets Act' the UKAEA have kept many of their activities secret. Local objectors are worried that any controversial findings arising from a programme of test-bores would be withheld from public scrutiny. The Secretary of State has already refused to postpone the inquiry to allow an evaluation of data from test-bores in Caithness. He is also unwilling to confirm that the results from any investigations allowed at Mullwharchar will be made public; "…..it is suggested that this question should be raised with the UKAEA either before or during the inquiry." In other words the results from any test-bores in Scotland will remain in the control of the UKAEA (well-practised in the selective release of information).

Mr Younger has confirmed, however, that a further inquiry will be required in the event that high-level radioactive waste is intended to be deposited at Mullwharchar. He is not willing to give any guarantees on the format of a future inquiry. Any proposal to bury nuclear waste is not expected to arise for at least another ten years. By then, with the government intending to embark on a new construction programme of nuclear reactors, with nuclear waste building up all the time at Windscale, the case for the disposal of waste will be compelling. This, together with the fact that public money will have been spent on a research programme at Mullwharchar, will exert irresistible pressure on the outcome of any future inquiry. Residents in South-West Scotland are worried that their proximity to Windscale, will mean that their interests will be sacrificed 'in the National Interest.

The real questions, to which the people of South-West Scotland are demanding answers are: How can we bring to account an industry which should have tackled the technical and political problems of nuclear waste 25 years ago? And why does the Government refuse to fully exploit the alternatives to nuclear power?

Groups all over Britain have been calling for greater opportunities for public participation in dealing with energy developments. The Government has stated clearly its intention to embark on a large nuclear programme, at a time when all other public services, including those related to energy conservation, are being cut back. The Government also seems determined to find a method of waste disposal, yet realise that publicly airing the problems associated with waste dumping would add to the serious questions about the sanity of expanding the nuclear programme. If Mr Younger continues to refuse to widen the remit of the forthcoming inquiry in Ayr, it is difficult to see how public confidence in any future public inquiries can be maintained.

*P. J. Roche*

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## NUCLEAR POWER IN SPAIN

There are signs that the present Spanish Government has at last reached a definite decision with regard to nuclear power policy. The Government theory is that there is no other effective answer to the energy problem except nuclear power stations. By a very skilful use of the mass media, especially radio and television, backed up by a sharp rise in the price of electricity (16%), opposition to this policy has been reduced to a minimum - except for the sabotage of two plants already under construction before the Harrisburg disaster, which will delay their completion by about two years.

Ministers and carefully chosen scientists appear on television and point out, as a justification for the policy, that, even if the hydro-electric possibilities of the country were developed to the maximum, that would still only cover 10% of the estimated needs in the foreseeable future. The use of coal-fired stations is limited by supplies of raw materials, although the Government has just approved an allocation from the present budget for the construction of two or three more.

Before the Harrisburg accident the Government intended to build ten new reactor stations over a period of ten years, two of them of French design and eight pressurised water reactors, probably from Westinghouse, U.S.A. In spite of the fact that it was one of these PWR's involved in the Harrisburg case, it would seem that there has been no fundamental change in the policy. The opinion in Government circles seems to be that 'it could not happen here'.

It is interesting to note that any opposition to this Government policy is not directed against the decision to construct nuclear power stations, but simply against the chosen locations. The industrial areas of Spain want the nuclear energy, but they do not want the stations to be located in their Provinces. Having been convinced, by skilful propaganda, that nuclear energy will be cheaper, the industrialists of Cataluna and the Basque Provinces want that energy, but without the risk! One wonders if that is possible.

So far as the Government is concerned, this situation could become more difficult as the various regions of the country obtain a certain degree of autonomy with regard to the central Government in Madrid, because it is almost certain that no region of Spain would want to include voluntarily a nuclear power station within its bounds. Here the Government would be faced with three alternatives; to impose its will on the regions concerned by force and, if necessary, by legislation; to convince Local Authorities that there is no risk in the nuclear stations; and, finally, to offer a substantial cash benefit, based on the quantity of energy exported, to those regions which encourage and permit the building of such nuclear stations within their confines. The last would seem to be the only possibility of overcoming the difficulties.

Apart from the risk of sabotage by terrorist groups - very much on the cards at the moment - there is always the risk of human error.

There is a lot of talk about the use of solar energy but, in spite of the fact that Spain has plenty of sun, little is being done to exploit it at a practical level or to foster scientific investigations into the possibilities. In Government circles the idea seems to be that solar energy is a very long-term policy, a opposed to the relatively immediate results offered by nuclear power stations.

*David L. Greenstock*

**GREEN PARTY FOR CANADA**

The first signs of the emergence of a future Ecology party could be discerned during the recent Federal Election Campaign Canada. Although there was no official party with set policies and a manifesto, eleven candidates ran as independents, mostly in ridings in Eastern Canada, under the banner of "The Small Party".

The primary objective of the campaign was to force the issue of Nuclear Power onto the other candidates. Dr Gordon Edwards, spokesman for the Canadian Coalition for Nuclear Responsibility, and running in Pierre Trudeau's Mount Royal riding, said in a Press release "Our objective in this campaign is to publicize the issue of Nuclear Power, educate the public about the renewable and conservation alternatives and to encourage the other candidates to take a stand on these issues."

The issue of nuclear power has never been previously debated in a public forum in Canada. Elected representatives have never actually voted to permit nuclear development and during the last Federal Election campaign, conducted only weeks after the accident at Three Mile Island, the nuclear issue was barely raised. At the beginning of this campaign, there were no signs that nuclear energy was going to be mentioned at all. A simple leaflet, entitled *The Small Party* states, "We live in a Democracy. A fundamental tenet of democracy is that those in government *are* accountable to the people. We have been denied an open public discussion on nuclear energy at other levels of government. If Canadian citizens are not allowed to register their concerns during a Federal Election, when are citizens permitted to discuss the nuclear question?"

The Small Party's electoral campaign was run on extremely limited resources. Each candidate was self-financed and its creation happened a month before the election date of 18th of February. Though the odds were so obviously against them, they nevertheless won their place in the media. Like Mr. George Bush, the "unknown" candidate in the United States Presidential elections, the Small Party was "discovered" by the media and given excellent coverage. Its most important resource was its "news worthiness" and this was exploited at exactly the right moment so that media attention was held right up to the date on which the election was held.

The campaign has provided the nucleus and, of greater consequence, the demand for a fully-fledged ecological party.

*Alexander Goldsmith*

# *GLEANINGS*

**HELP! POLICE! HELP!**

WASHINGTON — "Sergeant Riley, Fifth Precinct, Homicide Division, speaking."

"Sergeant, I would like to report a crime. Someone tried to poison my entire family."

"Are you sure?"

"I'm certain. I had my water and food analyzed by a laboratory and they were full of pesticides. Someone dumped the poison in our wells and rivers and not only my loved ones but all our neighbours may be croaking at this very moment."

"This is serious. Anybody have any grudges against you?"

"No one that I know of. Certainly we don't have enemies who would want to poison us."

"Maybe it's a crazy person who has some beef against the community. We better put out a dragnet."

"It's possible, but the person would have to have access to a lot of poison. Our pigs and cows are all sick and our horses are dying too."

"Let me get this straight. You think there is a mass murderer in your neighbourhood?"

"Sergeant, I think there is a mass murderer in the county."

"You're not a crook, are you?"

"No, sir. If you check my record I am a very respectable person and have never been in trouble with the law."

"Okay, do you have suspects?"

"Well, the Frankenstein Chemical Co. is about two miles from my house and they've been dumping all sorts of sludge in the river.

"Sometimes it's green, some times a dark red and other times it's a deep brown. They do it mostly at night so no one will see them."

"Wait a minute. The Frankenstein Chemical Co. is a multi-million dollar corporation with plants all over the United States. I know the men running the one in this county. They're lodge brothers of mine. Are you accusing them of poisoning people?"

"I know it sounds hard to believe, Sergeant, but I have this niece who works in the company's office and she has memos signed by two of the officers instructing the Frankenstein employees to dump all the

waste in the river at night. The memos say that if anyone questions them about it to deny they did it, because if they get caught Frankenstein will have to close down the plant and they'll all be out of jobs.''

''So what's the crime?''

''They're knowingly poisoning all of us. Isn't that a felony?''

''No, that's an environmental problem.''

''Let me ask you something, Sergeant. If someone came into your house and started sprinkling arsenic on your food and fed your dog DDT and poured cyanide into your children's milk, would you arrest him?''

''Damn right I would and I'd see he got sent up for life.''

''What's the difference between that and a company doing the same thing to an entire community?''

''The police only deal with individual crime. We have no authority to arrest company officials just because they have no way of getting rid of their pesticides.''

''Then you mean the average citizen has no recourse when a large corporation knowingly tries to kill him?''

''If the government thinks they're doing anything wrong they have ways of punishing people who dump their waste in the wrong place.''

''What's the punishment?''

''I think it's a 5,000 dollar fine. It could be less. But you better be careful before you make wild charges such as you have.''

''Why?''

''I can arrest you for harassing a respectable business establishment.''

*Art Buchwald*

**Aftermath of Agent Orange**

The delicate debate on the effect of Vietnam War herbicides on Australian soldiers has changed rank. The Vietnam Veterans Association is asking for an inquiry into the effects of Agent Orange, a 50-50 mix of 24-D and 245-T on serving officers who have been exposed to the toxins during the war. Pressure has been brought to bear on the Australian Defence Minister, James Killen, to call for the inquiry. As so many of the chemicals used were nerve toxins, affected officers are suppressing their symptoms with valium and tranquilizers for fear of losing their jobs and the ultimate humiliation of a medical discharge. As majors and colonels explain their symptoms incognito to the Veterans Association, one of their colleagues has already gone berserk in Perth. Meanwhile, the Defence Minister has denied that the Australian Army has ever used toxic herbicides in Vietnam, neither has he answered whether they purchased any. In New Zealand, 650 Vietnam veterans are pressing charges against the manufacturers of Agent Orange, on the grounds that a number of the vets have cancer directly attributable to the toxin.

*The Australian Bulletin 26.2.80*

Traces of dioxin, ranging from 3 to 57 ppt has been found in fat tissues of Vietnam veterans by an American Veterans Administration researcher in the US. 750 veterans out of the 5,000 who have been treated for herbicide-related illnesses, have filed compensation claims.

The Defense Department contends that ground troops did not enter sprayed areas until six weeks after the spraying, whilst the General Accounting Office of Congress, GAO, claim that army records are too incomplete to determine how many troops were in the sprayed areas and when. In fact, nearly 6,000 troops were within half a kilometre of the area sprayed with Agent Orange on the same day of spraying and over 16,000 troops within half a kilometre of the area within four weeks.

A working group has been established by President Carter to study the long-term effects of agent orange and to propose a compensation policy for veterans who claim to have become ill as a result of exposure to the herbicide.

*Environment Vol. 22 No. 1 80*

**'Dirty, Damp and Smelly'**

The Maruia Declaration, the biggest petition ever presented to the New Zealand parliament signed by over 341,000 people to protect the last of the indigenous forests, has been all in vain. The government remains hell-bent to relieve New Zealand of its remaining lowland forests where the kokako, a near extinct bird dwells. After nimble ecologists climbed the massive trees to thwart loggers' attempts to fell them, the Minister of Forests, Venn Young declared in one breath that 'the government is mindful of the need to protect our native forests and to use their wood resources wisely' and that they would not be 'needlessly sacrificed'.

The petition called for greater protection and the cessation of wholesale burning of forests and wildlife, and the phasing out of logging in virgin forests. As Minister of Forestry and the Environment, Young supports controlled burning to convert indigenous forests to exotics, and although agrees with the 'sentiments' of the petition, he manages to equate conserving natural resources with the legitimate development of exotic forestry.

Nevertheless, a slight improvement over one of his predecessors who stated that native forests were 'dirty, damp and smelly'.

*New Zealand Herald. 15.2.80*

**Monkey Business**

The Indian government is being persuaded by the Americans to lift their two year export ban on rhesus monkeys which earns them $17 million a year. Medical researchers claim the ban has slowed the introduction of new medicines and caused a shortage of polio vaccine. The Americans have vowed not to use the monkeys for nuclear weapon experiments whereby they are subjected to high radiation doses in the simulation of a neutron bomb explosion. Predictably, their hair falls out and after excessive vomiting, they eventually die. Tests of this nature, provoked the Desai government to stop the trade in 1978. The 1,200 rhesus monkeys bred in the US (costing $700-$1,000 compared to the $500 retail price for the wild variety), doesn't meet the annual demand of 20,000.

A vivisectionist's shopping list, retail price, might read as follows:

South Eastern Asian pigtail for behavioural medicines, $445
South American cebus, $335
African baboon for cardiac medicine, $700
Green monkey for tissue cultures, $290
Squirrel monkey for neurosurgery, $225

*New Zealand Herald. 25.2.80*

# Books

## Ancestral Attitudes

ECOLOGY IN ANCIENT CIVILIZATIONS by J. Donald Hughes. University of New Mexico Press, $9.50

To find in a book on ancient ecology a strikingly beautiful photograph, in lovely browns, mauves, and blues, of the somber, eroded mountains encompassing the River Peneios on its course through the alluvial plain of Thessaly should intrigue any Hellenophile or wilderness wanderer. It was presumably taken by the author, whose classical education, including a year in residence at the American School of Classical Studies in Athens, also embraced an abiding love of the outdoors. Now a university teacher of ancient history, Dr. Hughes has travelled widely on foot in the mountains of California, studied botany, forestry, and genetics, and spent seven summers as ranger-naturalist at Grand Canyon National Park. We must indeed listen to what he has to say about the new and challenging field of environmental history.

One of his important observations is in opposition to that of Lynn White, who maintained that the historical roots of our ecological crisis are to be found in the Judeo-Christian dogma that man is the rightful master and exploiter of nature. Hughes attempts instead to include other religious attitudes towards the Mediterranean environment, which, he points out, was exploited on an ever increasing scale by all the ancient civilizations in the area. While the prehistoric animistic societies had worshipped the spirits in natural objects and had a fully developed sense of oneness with nature, the early urban societies tended to separate themselves from it. Religious attitudes were changing, and with animism on the decline, no Mediterranean civilization was able to maintain its "delicate relationship" with the ecosystem. Thus Hughes, as Lynn White, assumes that our ecological crisis has religious roots and needs, at least partially, a religious solution. But since this theme is not rigorously developed, the book lacks a certain coherence and persuasion.

It does, however, cover a broad spectrum of subjects with a wealth of interesting detail about the ecosystems of the Mediterranean basin and the successive degradations inflicted upon them by the ancient civilizations. Mesopotamia, Egypt, Persia, Israel, Greece, Rome - all are ecologically guilty, and Dr. Hughes believes that one of the underlying causes of their decline and fall was failure to adapt harmoniously to the environment. They brought about deforestation, erosion, soil exhaustion, flooding, faulty drainage, disease, pollution, and not least a vast reduction in wildlife through unrestrained hunting as sport or organized business. In stating Aristotle's view that the proper end of animals is merely the service of man, the author points out that his "teachings about animals are the foundation of much of Western thinking about the relationship of mankind to the whole natural environment." Unfortunately, Theophrastus, the pupil of Aristotle, whose thoughts about purpose in nature caused him to reject his master's views, had far less influence on succeeding ages. It is equally unfortunate that Theophrastus' deep consistent interest in the relation of living organisms to their total environment (Hughes bestows upon him the title of Father of Ecology) had no effect in stemming the tide in his own time (370-285 B:C.) Actually during four centuries the Greeks felled whole forests for ships, temples, chariots, furniture, and fuel. They over-grazed, they overmined, they polluted the air of their cities, they exterminated the lion and the leopard, and with equal violence they fought and killed their fellow men (being aware that the battlefield had been well fertilized for the next year's crop by human blood). The Roman attitude towards nature was still more utilitarian than the Greek, and Roman devastation of the landscape was enhanced by their superior technology. The number of wild animals captured alive for mutilation and death in the arena is also indubitable evidence for the state of religious teaching during the glory that was Rome.

Dr. Hughes paints the ecological picture of ancient Greece and Rome skilfully and apparently in its true colours. Seven chapters are devoted to this subject, one of which is entitled Greek Religion and the Natural Environment. When he comes to the Judeo-Christian attitude towards nature, his painting becomes more hazy. This may be due to the real difficulty in responding clearly to biblical ambiguity about nature. On the whole, he seems to read into the bible more compassion, respect, and understanding towards the non-human than is justified. He states, for example, that the ancient Jews understood that God's ethical law was applicable to their treatment of nature, and that dominion was no licence to "kill, exploit heedlessly, and pollute." But ancient Jews, just as Christians, in no way respected the inherent right of animals to live, because they considered it ethically justifiable to hunt, kill, and eat them. To add that this kind of "human dominion is not necessarily seen (by Christians) as exploitive, however" only adds to the ambiguity of Christian ethics with respect to nature.

Although apparently holding the Judeo-Christian doctrine blameless for our ecological misdeeds, Hughes admits that fallen man, Christian and non-Christian, has failed as God's steward. Lynn White, on the contrary, stated that "Christianity bears a huge burden of guilt" for the uncontrolled scientific-technological powers that have hastened the present ecological crisis. Were we to know the truth about the message Christ and the apostles preached, we would better know whether it is Christianity *per se* (L.W.) or imperfect, unethical Christians (J.D.H.) that are most responsible for the present state of ecology. As far as the New Testament goes, man is not exhorted to give up his exploitive, carnivorous inclinations. All we know for certain is that the roots of our ecological crisis must be religious because, already long before Jesus, civilized man was beginning to turn away from the divine ethic. It is to be hoped that the New Age he is now entering will make him spiritually aware of his evolutionary obligations to higher ethical demands.

J. Donald Hughes has seen quite rightly that ancient history is a warning and a challenge to our environmental policies and wisely stresses that we must develop new ecological insights compatible with "many religions and philosophies." With this book, he has done much to put environmental history on the right path.

*Catherine Roberts*

## Not Tough Enough

DISASTERS: THE ANATOMY OF ENVIRONMENTAL HAZARDS by John Whittow. Allen Lane, £8.98

'This is not intended,' writes John Whittow in his introduction, 'to be a pessimistic book of the *doomsday* variety.' This is fair warning, and those looking for an impassioned denunciation of human tampering with the environment must look elsewhere. Mr. Whittow's prose is neither polemical nor alarmist: even in reporting the Soviet Union's experiments with nuclear engineering to create underground water reservoirs, he points out the hazards involved without so much as a ripple to disturb his level tone.

Man-made catastrophes such as the explosions at Flixborough and Seveso are specifically excluded from consideration, and so are biological calamities, which means that the contributions of human activity to epidemic outbreaks of disease go undisclosed. What remains is a careful study of the causes and consequences of such 'natural' hazards as earthquakes, volcanoes, hurricanes, floods, and avalanches.

Natural catastrophes have been attracting steadily more academic and governmental interest: there is now, for example, an *International Journal of Disaster Studies and Practice*, while the President of the United States has created, with the usual Washington linguistic flair, an Office of Emergency Preparedness. This trend, according to a joke now current, owes its origin to the covert activities of the nuclear-power industry, which wishes it to be generally understood that the world is by its nature a dangerous place to live in and a few PWRs here and there aren't going to make much difference.

Mr. Whittow's book, while it lacks an ecological perspective, (it is certainly not the study that, say, Edward Goldsmith would have written) — should be taken on its merits: it is a solid piece of work, offering both technical information and human interest, both in well-researched detail. Here, on the one hand, is the place to find out about dextral wrench faults, subduction zones, ropy lava, glacio-eustasy, advection fog, and *haboobs*. Here too, one can read accounts of disasters as they occurred, sometimes in the words of first-hand obsevers. Thus, an American woman in St. Pierre in 1902 during the volcanic activity of neighbouring Mt Pelée writes of sulphur fumes so strong that horses dropped dead from suffocation in the street and so hot that the townspeople wore wet handkerchieves in an attempt to protect their noses. Amazingly, this woman chose to remain in the town - convinced by newspaper articles that the activity would subside harmlessly - and perished in the subsequent eruption; the sanguine attitude of those put in peril by disasters is one of the book's recurring themes.

To sum up, then, *Disasters* is the work of an academic whose main interest is geology, and it has the qualities which that might lead one to expect. It is informative and readable, and the author's refusal to rush to a conclusion can be refreshing as well as irritating. The photographs, more than fifty of them, are stunning.

*Bernard Gilbert*

## Aid fills no Bellies

WORLD HUNGER: TEN MYTHS by Frances Moore Lappé and Joseph Collins (Institute for Food and Development Policy, San Francisco; distributed in the U.K. by Third World Publications Ltd., 151 Stratford Road, Birmingham)

Anyone who still thinks that international aid is the answer to world hunger should read this tract. The authors show that virtually every country could feed itself if it had the political will so to do. Land reform and redistribution of internal wealth can eliminate hunger without recourse to new agricultural techniques, whereas most forms of aid — even if they increase food production — chiefly benefit already well-fed elites.

When agricultural productivity goes up, for example, farming becomes a more attractive investment, so land values soar, and rents climb beyond the reach of peasant and tenant farmers. Catastrophically the 'green revolution' has doubled the landless in India, and in some underdeveloped countries has increased the size of farms ten-fold (making them capital-intensive in the process). Often the result is increasing involvement of multinational agribusiness, perhaps in partnership with elite, local absentee landlords, and the best land being turned over to the production of luxury foods for export. Avocadoes and steak before millet.

Yet all is not lost. The authors claim that less than half the world's cultivable land is now being cropped, and that much land which could be cropped two or three times a year is only cropped once. Lappé and Collins also conclude that export agriculture is an effect rather than a cause of world hunger.

More food doesn't necessarily mean less hunger: their analysis is correct, but they are much less convincing about what should be done. They glance starry-eyed at China and Cuba but fail to note any shortcomings in socialist agricultural systems. The Soviet Union receives not a single mention, despite the authors' left-wing — for Americans extreme left-wing — sympathies. Russia's food production failures are too well-known.

Nor does Ten Myths examine countries like Tanzania, where forms of socialist land reform falling short of the whole Marxist hog, are proving scarcely less disastrous than those adopted in the USSR. With more aid per capita than any other country, hungry Tanzania is, of course, a good illustration of Lappé and Collins's main thesis that aid fills few empty stomachs.

Many of the authors' strictures on official aid policies — particularly military assistance programmes, credit arrangements which in the end only help multinationals, and the strings attached to IMF borrowings — need to be shouted from the rooftops. However, they devote too much space to criticism of agribusiness in view of their opinion that export agriculture is not a major cause of world hunger.

Ten Myths was 'thoroughly revised' in 1979, but evidently before the full horror of recent events (not unconnected with land reform) in South East Asia was grasped by the Institute responsible for this publication. I cannot believe that the authors still support the forces which have created tens of thousands of boat people in Vietnam and holocaust in Cambodia, nor that they would any longer refer to those same forces active against Thailand as 'brave men'.

Politically ingenuous, Lappé and Collins still deserve a hearing. The conclusion to be drawn from their book is that the developed North should tell the Third World that it does not accept responsibility for hunger which arises from social and political causes. The rich should be

very generous in response to acts of God, such as earthquakes, but cheerfully indifferent when hunger arises from acts of unscrupulous Third World leaders. At the same time they should drop aid and investment policies which could magnify world hunger.

*Victor Gordon*

## An Objective Look at Future Energy

RENEWABLE ENERGY by Bent Sørensen. Academic Press, 1979. £20.00

This book is one of six titles from Academic Press on the theme of Energy Science and Engineering. The author writes from the Niels Bohr Institute in Copenhagen, but he is far from being an apologist for nuclear power. He has, in fact, published papers on solar and wind energy. His scientific and technical presentation in this book is impeccably non-partisan, but he seems to favour the fullest use of renewable energy technology, while withholding judgment to some extent until fusion power proves to be viable or not.

Dr. Sørensen envisages his typical reader as "a research worker or student working somewhere within the field of renewable energy", and he also hopes to attract "readers in the energy planning and management sectors". He is too modest. The book seems sure to become a standard work of reference not only for these people but also among campaigners for environmental protection and new lifestyles.

The emphasis in this book is on principles and methods, which are treated concisely but thoroughly. Existing renewable energy installations are only covered selectively, but plenty of illustrative figures are supplied. For example, all the variables in the design and operation of a solar heating system are methodically discussed in a few pages, and illustrated later by figures pertinent to Danish houses, apartment blocks and office buildings.

After an introductory chapter, Dr. Sørensen discusses the origin of renewable energy flows: solar radiation, the nuclear reactions giving rise to it, and its partial transformation on the earth to heat, biomass and the movement of wind and water. In the next chapter, these energy sources are discussed individually, as they present themselves to users in various parts of the world. There follows a chapter on the conversion of renewable energy from its natural forms to electricity, heating, and storable materials, such as ethanol and hydrogen. Among the many subjects covered here are wave-power devices, heat pumps and heat engines, and biological heat sources. The next chapter, on energy transport and storage, is relatively brief but includes novel schemes such as storage in superconducting magnets and underground compressed air reservoirs, besides more conventional methods. The long chapter on energy supply systems which follows is particularly impressive and instructive. Here the author addresses the problem of matching the fluctuating and somewhat unpredictable supplies of renewable energy to the energy needs of society. The alleged impossibility of doing this is a favourite argument of the nuclear power lobby. However, Dr. Sørensen gives outline plans of complete, essentially self-contained renewable energy supply systems for countries in low, middle and high latitudes. He also provides more detailed studies of two representative systems: solar heating for buildings, and wind-generated electricity supply with and without storage. This chapter conveys the clear message that total conversion to renewable energy is feasible, and that an advanced society can plan the difficult transition period if it has the will. The last chapter, a socio-economic assessment, is largely about the advance costing of energy-supply systems, and the inadequacy for this purpose of conventional economic criteria. Government departments should note a point made here: systems with small unit size, in contrast to large units, allow for bad investments to be discontinued while the total investment is still modest.

Only in the first and last chapters does he step aside from his strict technical objectivity to make some wise and undogmatic remarks on the goals of society; he is against the use of GNP as a measure of living standards, and in favour of small-scale local energy enterprises as opposed to large centralized ones.

This book is the finest piece of technical writing to have come my way in many years as a reviewer. Dr. Sørensen writes straightforward, excellent English. The references, over four hundred of them, show the breadth of his cross-disciplinary approach. They range from Karl Marx to Amory Lovins, and include primary papers (published up to 1977) on physics, astrophysics, earth sciences, biology, engineering and economics. The diverse threads are woven into a connected story in a way which looks effortless, but most certainly could not have been. We are not expected to compare megatons of coal equivalent on one page with kilowatt hours on another; all the energy values are in joules, and the SI system of units and symbols is employed throughout. The diagrams are abundant, clear and well labelled.

*Renewable Energy* is an outstanding book, crammed with information and ideas, and splended value.

*Henry Heal*

# Letters

## A Controversial View

Dear Sir,
Reid Bryson of our University's "Institute of Environmental Studies" has asked me to reply to your inquiry concerning likely climatic effects of widespread destruction of the world's tropical forests. Based on parts of my recent research work, let me briefly summarize two items which appear relevant to your question.

[1] A case of complete destruction of tropical rain forest cover occurred on the island of Krakatau [about 50 km², located in the Sunda Strait] by the volcanic explosion of 1883. Well documented by botanists is that within no more than about four decades the sterile lava and pumice desert changed to grass and fern savanna, then to young forest, and finally back to complete rain forest cover. By numerical modelling we have found that transient micro-climates of extreme severity existed after 1883, but were not stable and finally overruled by the unchanged macroclimate of the tropical marine monsoon regime with ample annual total precipitation.

[2] On the large scale of the Amazon Basin [about 6 million km²] we assumed a 50% reduction of forest cover in the central 2 million km² of Amazonia. Our numerical modeling of climatic effects is described in "Monthly Weather Review", 1979, Vol. 107, under the title "Amazonia's Hydrologic Cycle and the Role of atmospheric Recycling in Assessing Deforestation Effects". The model predicts increase of annual mean air temperature by about 0.5 Celsius, a slight increase [by about 75 mm] of annual total precipitation, but drier soil and reduced runoff because the cause of precipitation increase is faster recycling, [i.e., more efficient use of regional soil moisture on this inner continental plain area].

In conclusion, the two tropical case studies suggest that desertification can be overruled by nature and that partial deforestation will not lead to desertification.

Yours faithfully,
Heinz H. Lettau
Professor
University of Wisconsin
Madison, Wisconsin, USA

## Long Term Benefits

Dear Sir,

Would it be a good idea if farmers and land owners planted oak trees, at fencing distance apart, on their boundaries and permanent fencing lines. They would have to be fenced against cattle where necessary [six feet away from oak planting]. When trees [about six years] are stout enough or by the time the protection against cattle has rotted, the oaks can be used as the fence line and will last for two or three hundred or more years. Think of the saving, not only in the cost of fencing but labour costs and time saved. Plus the great ecology value, food and cover to wildlife.

Yours faithfully,
Miss Greta Grimshaw,
Woodborough,
Wiltshire.

## Have a Cup of 2,4,5-T

Dear Sir,

I read with interest your article on tree diseases by Edward Goldsmith. My attention was drawn to the footnote on the herbicide 2,4,5-T, as until very recently we have been using this chemical to poison undergrowth for the Forestry Commission. We objected to using it when it was cast in an unfavourable light by T.V. programmes and reports in the press. However, we were assured by our superiors that "one could drink it" and they produced documentary evidence from government research teams to substantiate this claim.

Could you send me the name and address of the research institute that discovered that 2,4,5-T is carcinogenic, so that if we are asked to use it in the future we can decline, knowing for certain that we are in the right.

Forestry Worker
[Name and Address supplied]

## Fluoride and Cancer

Dear Sir,

The article by Professor Samuel Epstein in your Oct.-Nov. 1979 issue and the review of his book 'the Politics of Cancer' in the Sept.-Oct. 1979 issue, showing the indifference of the medical and scientific professions in the U.S. to the need for carcinogen regulation, and the neglect of regulation by industry in the name of fighting inflation, are horrifying.

It brings to mind the similar cavalier attitude of the National Cancer Institute in U.S. and the medical and dental professions in Britain to the studies by Dr. Dean Burk and Dr. John Yiamouyiannis in the U.S., which revealed a greater increase in cancer death rates in the ten largest cities with fluoridated water supplies in the U.S., since fluoridation commenced, as compared with that of the ten largest nonfluoridated cities.

The Ecologist was, I believe, the first journal in Britain to publish a reference to these studies in a letter from R.V. Mummery L.DS.RCS. in the May 1976 issue.

The final study, published in Fluoride [July 1977], was the central issue in a case at the Alegheny Court of Common Pleas during 1978 at which the judge decided that the evidence showed that fluoride is carcinogenic and ordered the prohibition of its addition to water supplies in part of the Pittsburgh area.

Since then Dr. Burk has reassessed figures quoted by the Royal College of Physicians purporting to show no increased incidence of cancer in fluoridated areas in Britain, and has found that these do indeed show an increase in line with American studies. He is now investigating the sharp increase in Birmingham's cancer death rate since fluoridation began in 1964.

Recently Dr. Gerard Vaughan, Minister of Health, has been reported as saying that Dr. Burk's evidence is too important to ignore. It is to be hoped that he will reject the unwise recommendation by the Royal Commission on the National Health Service that fluoridation should be made compulsory. I think that there are already too many carcinogens in our environment without deliberately adding another one to all drinking water supplies.

Yours faithfully,
I. Renson M.P.S.,
Hackney,
London.

## Support for W.E.A.P.

Dear Sir,

On behalf of our Resources Committee I would like to congratulate you on your initiative on Tropical Rain Forests and pledge our Group's full support to W.E.A.P.

As you may know, we have already begun to circulate Conservative M.P.s with an appeal for action and subject to your consent we would like to produce a second forests paper, based on your January edition of the Ecologist. We see the preservation of the forests as the top priority in ecological reform.

If it will be of any use to you, you may use our name as a supporting Group for the W.E.A.P. plan. Our own attempt to persuade environmental organizations to get together on this issue last year met with a very poor response. We hope therefore that you may succeed in achieving some unity.

Yours faithfully,
Richard Williams,
Secretary,
Conservative Ecology Group,
Waterlooville, Hants.

### Big Oaks from Little Acorns Grow

*Dear Sir,*

*All of us have seen the severe lack of trees in our countryside - especially the lack of trees on farm land, in hedgerows etc. due to Elm disease and the after effects of the drought. While some farmers have taken the trouble to replant, there are many who have not [through lack of time and money].*

*My suggestion is that those of us with spare plots of land, use it to sow acorns sycamore keys, beech must, ash seed etc. and raise many small saplings, which we then offer to plant for farmers on odd corners where the plough cannot reach. If people all over the country could do this, it would be an effective way of arresting the decline of our tree cover.*

*Yours faithfully,*
*Simon Smith,*
*Cirencester,*
*Glos.*

### Unmentionable Subject?

*Dear Sir,*

*Thank you for sending me the information about W.E.A.P. and its proposals for helping to save the world's tropical forests, all of which I find very encouraging. But, as in all conservation projects and discussions, the basic reason for having to have them at all, the grossly swollen human population, is not even mentioned.*

*No conservation effort can hope to be anything but a temporary palliative unless it is regarded as a holding operation to slow up deterioration whilst the politicians and church leaders actually start doing something about it: at least something which might result in a 'nil-growth'. No conservation body even mentions the subject, let alone urges action.*

*I should mention that these are my personal opinions and are not necessarily those of the Royal Forestry Society.*

*Yours faithfully,*
*P.S. Leathart,*
*Editor: Quarterly Journal of Forestry,*
*Alnwick, Northumberland.*

### Religion, Psychology and Nature

*Dear Sir,*

*For the past two years I have been writing a large* annotated bibliography *on psychological, aesthetic, esoteric, philosophical and spiritual aspects of the encounter of man with nature, mountains, forests and wild animals. These aspects seem distressingly under-estimated among militants. Nevertheless, the historical evolution of appraisal and perception of landscapes, the role of plants and animals in mythologies, legends and folklore, the ancient worship of trees, forests and fountains, the sacredness of mountains and the mystcal appeal for high altitudes or deserts, the place of natural beauties in symbolism, literature and poetry, rural traditional wisdom and the back-to-the-land revival in the years 1920 - 1940, the influences of cosmic and telluric rays on human health ... all these are entrancing fields of interest. These facets of human ecology, in the broad sense of the term, deserve personal research, to foster, enlighten and justify the aims of the Ecology Movement. Man depends upon the global protection of the Earth, not only for his material well being but also for his mental and spiritual fulfilment.*

*I would like to get in touch with all the people who are interested by these subjects in order to exchange references, old books and eventually form a group of collective research. Please send me photocopies of articles on these subjects.*

*My address is:*
*Roland de Miller,*
*12, rue des Amoureux,*
*F 74100 Annemasse - France.*

### Will you Sponsor an Acre of Forest?

*Dear Sir,*

*I am writing in response to the publicity given in last week's press and on the radio to your concern regarding the future of the tropical rain forests.*

*I wonder whether it would be possible to raise some of the large sums of money required by involving the individual. We must all individually share a responsibility for the ultimate safeguarding or destruction of the world's rain forests and perhaps with the appropriate persuasion there could be significant individual contribution. Perhaps it would be conceivable to organize on a massive scale some manner of collective sponsorship of large areas of rain forest based on similar lines to the already well-established sponsorship of Third World children. Instead of the financial backing for a child's welfare and education, the individual would contribute to the preservation of a specific area or plot of rain forest. If successful on a vast scale, money derived could constitute an alternative income to that provided by present deforestation and, subsequent land use.*

*However, I believe that crucial to any such scheme would be the education of prospective sponsors i.e. all of us. So few people have much awareness of the vital role of the tropical rain forests. There is none of the immediacy, proximity or drama of increased petrol prices, polluted beaches and nuclear anxiety. None the less there could be real hope for world sponsorship if this reality could be successfully taught: that the loss of the rest of our oil during the next 25 years could be considerably less catastrophic than the irreparable loss of our rain forests.*

*Yours faithfully,*
*D. S. Chick,*
*Broadstairs,*
*Kent.*

# Classified

## BOOKS & PUBLICATIONS

INDUSTRIALISM, PATRIARCHY, MATERIALISM: You can't have one without the others. For the spiritual-feminist alternative, read *The Coming Age*, 45p. 40, St. John St., Oxford. A pre-industrial faith for the post-industrial age.

LOOKING FOR APPROPRIATE ALTERNATIVES: Write for: 'Technologies too Hot to Hold' which includes an indispensable bibliography with many valuable sources of information, send 70p + SAE to: J.A. Farrar, Regenerative Technology, 22 Greywethers Avenue, Swindon SN3 1QF.

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PENFRIEND WANTED: I am a girl of 18 years old. I live in Japan, my hobbies are oil painting and making dolls. Please write to: Emiko Iwase, 571-1 Higashiyajima, Ota City Gunma-Ken 373, Japan.

## CONFERENCES AND COURSES:

ECO—PHILOSOPHY CONFERENCE, Dartington Hall, South Devon, July 11-13. How Philosophy relates to Ecology and Health. Speakers include James Robertson, Max Payne, Philip Stewart and Henryk Skolimowski. Residential Fee £50.00. Applications by 31st May to Mrs. I. Allison, Dartington Hall Trust, Totnes. (Tel. Totnes 862746)

The Institution of Environmental Sciences holds a conference on NUTRITION AND KILLER DISEASES on Wednesday, 28th May, 1980 at the Royal Society of Medicine, 1, Wimpole Street, London W1M 8AE. Chairman Sir Richard Doll, FRS; Master, Green College, Oxford. Details from Dr. J. Rose, C/O College of Technology, Feilden Street, Blackburn BB2 1LH, Lancashire.

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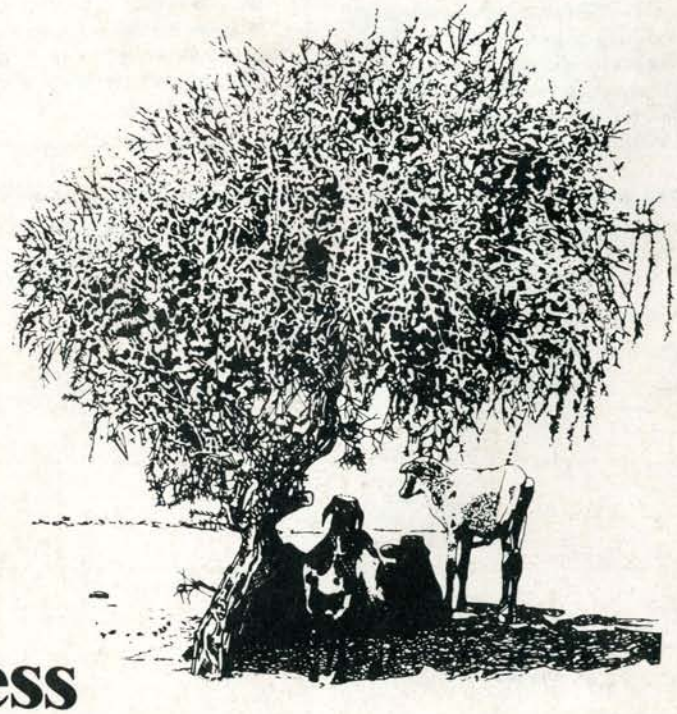

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