



ANUMUKTI

A Journal Devoted to Non-Nuclear India

Volume 9 Number 4

February/March 1996

Attempting to Fool Some off the People All the Time

recent news item in 'the
A Meghalaya Guardian
(August 1, 1996) states
that "The Uranium Corporation of
India Ltd (UCIL) proposes to ac-
quire ten square kilometres of land
in the uranium deposit areas of
Domiasiat in Hima Langrin of the
West Khasi Hills at a compensation
of Rs 8 crores." About 30,000 peo-
ple are likely to be displaced and
the UCIL is promising to provide
85 percent of the jobs to locals of
the area.

As early as 1954, when Shri Vish-
nuram Medhi was the Chief Minis-
ter of Assam, the government had
laid claim to all the minerals in the
state including coal and limestone.
This proposal had been strongly
opposed by the local leadership
and in 1958 at the time when Shri
B. P. Chaliha was Chief Minister,
the government had abandoned its
claim. The leader of the opposition
Mr. B. B. Lyngdoh feels that the

government cannot now displace
the tribal population of the area to
mine uranium.

The first news regarding the ura-
nium deposit found in the area was
in a news item in the Indian Ex-
press on the 13th of August 1991.
In that it said that the "deposit is
the largest, richest, near surface
and low cost sandstone type ura-
nium deposit discovered in India
so far. The ores are spread over a
ten square kilometre area at depos-
its varying from eight to 47 metres
from the surface. Six layers of vary-
ing dimensions with grades up to
0.41 per cent of uranium oxide
have been delineated by drilling.

The Atomic Mineral Division of
the Department of Atomic Energy
had discovered uranium in the
West Khasi Hills some time before
1991. In the name of prospecting
and taking samples they have al-
ready taken out vast quantities run-

ning into hundreds of tonnes of
ore. This was strongly opposed by
the local population. Mr. P. P.
Lyngdoh, President of the youth
wing of the Hill State People's
Democratic Party has been active in
opposing this 'illegal mining'.
Now, the Uranium Corporation of
India has decided to 'properly' ac-
quire the land and do legalised de-
struction.

As part of their efforts to stop this
assault on their territory, people
had also sent a letter to the Prime
Minister. The Department of
Atomic Energy had been asked to
explain and in its letter of reply
had the cheek to say the following:

"The natural radiation level is
relatively high around Domiasiat
because of the relatively higher
concentration of uranium in the
area. The higher concentration in
the Killing Nale section is related
to the fact that the uranium ore-

body is exposed along the banks of the Nile, whereas, elsewhere the sediments over the ore-body have helped in reducing the radiation level at the surface. Therefore, the present level of radiation in the area is a natural phenomenon, not induced by the exploration activities of the Atomic Minerals Division and will remain there for thousands of years if the uranium ore-body is not mined. Mining will only help in removing the uranium, which is the source of the radiation."

The letter dated 12/4/95 is signed by Shri B. K. Satra, Joint Secretary (R&D) and has been sent from the Department of Atomic Energy's office in Bombay.

This is a just an example of how the government through its paid scientists tries to fool the people all the time. Doesn't this worthy know that although uranium is the source of radiation, in any ore-body there are many other radionuclides, the so called uranium daughters and although most of the uranium is removed from the site after mining more than 85 percent of the radioactivity remains at the site. And mining of the ore are just means the sediments over the ore body are removed so that it gets exposed. Milling of the ore makes the ore into a powdery form so that radon 222 which is a decay product of uranium in the ore and is itself a radioactive gas gets released to the atmosphere. Free of the confinement placed by nature, these radionuclides some of them with half-lives as long as 80,000 years, cause havoc in the surroundings. The effect of uranium mining all over the world has been to increase the radioactive burden on the people and the environment. To give an impression that mining shall reduce radioactivity in the region is not only fraudulent but stinks of contempt for human rights

Surendra Gadekar.

From *The Editor's Desk*

In our last issue, I had promised that we would be bringing out a special double issue on Chernobyl. However, I find that the amount of new material on Chernobyl is so enormous that to read it and edit it to make an interesting Issue is a task that takes time. So this issue is what is called in the jargon as a quicky. It is something like what the nuclear authorities in India did right at the beginning of the nuclear power generation programme. They had decided to go in for CANDU type reactors since they used natural uranium which was available in India and had on-line refuelling capability which left the much cherished nuclear option in the state of delightful ambiguity and other reasons as well. However, after finalising the decision to go in for CANDUs, they were offered a deal they could not refuse. General Electric Co. was willing to give a set of its Boiling Water Reactors so cheap that despite the disadvantages of becoming dependent on a foreign source of fuel (since India did not and still does not have enrichment facilities for making the kind of fuel required in these reactors and also the disadvantage of having two different types of reactor systems operating in the country, nucleocrats decided to do a quicky and the Tarapur reactors were built. The fact that dependence on fuel for Tarapur was exploited by the US to bring pressure on India to toe the line is another story.

This quicky issue of Anumukti would not have been possible without the ubiquitous foreign hand behind it. Unlike the help for Tarapur reactors, or other nuclear or even non-nuclear mega projects, which have a client server relationship, this help is mutual cooperation between friends. The *World Information Service for Energy* is a small group of young activists based in Amsterdam who bring out a fortnightly news communique. They act as a worldwide clearing house for information regarding nuclear issues. During a recent visit abroad, we visited them and renewed the bonds of friendship. Most of the stories in this issue have been taken from various WISE news communiques of course with some editorial comments added.

Energy & Security

Another group with whom we had a very fruitful interchange was Insitute for Energy and Environmental Research (JEER) in Washington. They bring out a newsletter, *Science for Democratic Action* which demystifies the jargon associated with nuclear enterprise in America and helps grassroots activist groups with technically sound but accessible information. They wish to bring out a global quarterly journal, "*Energy and Security*" on similar lines. This would deal with issues of disarmament, non-proliferation, and sustainable energy lifestyles. The first issue ought to be out within a few days and we would arrange to send a sample copy to subscribers of Anumukti. If you want to continue receiving the journal (free) please do drop in a line to us in reply.

The Skeletons in the Cupboard Keep Appearing

1958 ACCIDENT AT GREENHAM COMMON

One of the persistent comments often heard about the Chernobyl disaster in Western media has been that the communist government of the Soviet Union tried to hide the truth from its own citizens. This is said with so much contempt that one takes it for granted that the 'freedom loving', democratic governments of the West could never even have contemplated keeping its citizens in the dark. What one finds rather is that these governments because of their veneer of openness managed to hide inconvenient facts not for a mere two days as the Soviet Union managed to do but for well close to thirty years. Truly it has been said that Western democracies manage things better.

The Campaign for Nuclear Disarmament (CND) has uncovered documents which show that for over 30 years the British and American governments deliberately covered up a serious nuclear accident at the US Air Force base in Greenham Common (UK). The accident, put at risk the lives of hundreds of thousands of US and British service personnel, civilians working on the base, local residents, peace campaigners, police officers and journalists. Local land and animals were contaminated. The radioactive dust from the accident continues to pose a serious threat to the local environment and to the health of local residents in an area renowned for an unexplained cancer cluster.

The accident occurred at 4.25 p.m. on February 28, 1958, when an American B-47 nuclear bomber - loaded with its nuclear weapon caught fire. The aircraft awaiting take-off on the runway was engulfed in a fireball when a wing-tip tank carrying 1,700 gallons of fuel from another B-47 flying overhead was accidentally dropped. The fuel tank landed just 65 feet behind the parked B-47 and directly in line with it, igniting on impact and engulfing the plane. The bomb burned, releasing deadly uranium and plutonium oxide powder over an area of several miles around the base. The conventional explosive in the warhead exploded, helping to scatter very fine uranium and plutonium particles. Because of their high magnesium content both the aircraft and its payload burned extremely vigorously. In fact the aircraft was simply allowed to burn out because it was impossible to extinguish the magnesium. The fire was still smouldering five days later, the heat reaching temperatures as high as 1,000 degrees Celsius, explosions could be heard for miles around, and local firemen at first believed that there had been an atomic explosion at the base. A man underneath the aircraft at the time - who may have been involved in the bomb's loading procedure - was burned to death. A number of other service personnel were killed and injured in the accident. A board of officers was appointed to investigate the accident. Its findings are still secret. It is not known what happened to the wreckage of the plane or the bomb.

In May 1960, a group of scientists working at the atomic weapons research establishment (AWRE) at Aldermaston detected, almost by chance, highly radioactive readings near the establishment which could not possibly be explained by its emissions. They used readings taken from laurel leaves, which are highly accurate indicators of uranium contamination, and discovered that the amount of uranium-235 to the west of Aldermaston was one hundred times greater than could be accounted for by AWRE's discharges. When plotted, their readings showed hourglass-shaped contours of radioactive contamination centring around the runway at Greenham Common, which at the time was the base for US Air Force B-47 bombers on constant "Reflex Alert", loaded with nuclear bombs and ready to fly to the Soviet Union at a few minutes' notice. The findings were written up in a secret report called "The distribution of uranium-235 and plutonium-239 around the USAF Greenham Common, Berkshire and submitted in August 1961 to Sir William Penney, the head of the UK Atomic Energy Authority (UKAEA) and one of the architects of the British nuclear program. The research team was led by R. Morgan, a radiochemist from Aldermaston. The report carries no AWRE or UKAEA report reference number and is not in any of the standard classified reports series produced by Harwell and Aldermaston. However, the government has recently confirmed the existence of this report and told Parliament that its contents would re-

main secret. The report states clearly that the quantities involved and the wide dispersal are such that "the release must have been accidental. Further, in order to release 10-20 grams of finely dispersed uranium, much larger amounts must **have been involved** in the accident and it **seems the only possible way such a large quantity could become powdered** is through **the agency** of fire."

Parts of this report have now been obtained by CND, including a map of the spread of contamination from the accident around West Berks hire and North Hampshire. CND has also obtained secret letters written during the investigation, and has learned about other official government investigations which have confirmed that a nuclear accident did indeed occur at Greenham Common.

As recently as 1994, a follow-up survey by Aldermaston scientists of the area detected contaminated fall-out from the 1958 accident. A total of between 10-20 grams of uranium was released and dispersed outside the base, yet no clean-up operation has ever been mounted. A much greater amount of plutonium and uranium was certainly deposited inside the base itself on and around the runway - the warhead involved contained about 20 kg of plutonium and 30-40 kg of enriched uranium - yet the contaminated runway has been crushed and now stands in piles blowing dust over the surrounding area. There is a well-known cancer cluster in the area, and official government studies have confirmed an unusually high incidence of radiation-linked cancer among children living in the area.

The accusing finger has been pointed at the AWRE at Aldermaston and Burghfield, but detailed studies have been unable to find a link between these establishments and cancer among local children. Persistent reports of unusually

high and radiation-linked cancers in the area were first revealed in letters to *The Lancet*, a medical journal, in November 1985 and February 1986. The first letter stated that "since the establishment of a paediatric oncology/haematology clinic at the Royal Berkshire Hospital, Reading, in 1971 we have been concerned that we were seeing more children with acute leukaemia than might be expected in a population the size of our health district's". In 1989, the government appointed its Committee on Medical Aspects of Radiation in the Environment (COMARE) to investigate the claims, and specifically to establish whether there was any link between the cancer clusters and Aldermaston and Burghfield. COMARE concluded that there was a "small but statistically significant" increase in the number of cancers that would be expected among young children in the area. However, it was unable to find any link between its findings and emissions from either Aldermaston or Burghfield. Greenham Common was not included in the COMARE study, even though the government knew that the spread of radiation recorded in a 1961 study covered much of the area looked into by COMARE. Other areas covered with contaminated dust by the Greenham Common accident were excluded from the COMARE survey. The Ministry of Defence did not tell COMARE's research team about the accident at Greenham Common, and did not pass to them either the original 1961 report or the 1987 Saxby report. (A study has been written up by W. N. Saxby, a Technical Staff Officer from Aldermaston's Safety Division, and an experienced scientist who had been involved in monitoring fall-out from Britain's atmospheric atomic tests in the South Pacific. Saxby's report confirmed that a nuclear accident had taken place at Greenham Common and found the same hour-glass shaped deposits of contamination around the runway that were found in the first report

of 1961, The Saxby report is

The 1961 report by Aldermaston's scientists directly disputes the American base commander's statement who denied that the accident involved nuclear weapons. The scientists claim "We suggest that, in fact, a nuclear weapon may have been carried in the aircraft and burned with it," Radioactive debris from the bomb was stuck to Greenham Common's runway by the firefighters' foam. However, the scientists found that the contaminated debris has been repeatedly disturbed by vehicle and aircraft movements and Jet blasts wearing away the runway surface and causing radioactive dust to be blown out of the base into the surrounding countryside. In particular the report warns about the danger of continuing to use the runway because "the high temperature of the air from the jets would cause it to rise, carrying dust and sand particles up with it". The hour-glass shaped concentrations of radiation materialised because Greenham Common has just one runway with two take-off directions.

It emerged in 1979 that the British and American governments had agreed in 1956 to deny that nuclear weapons were present in any accident involving American nuclear bombers stationed in the UK. The agreement surfaced after details of another crash involving a USAF B-47 - which crashed into a nuclear bomb storage bunker at RAF Lakenheath in 1956 - were revealed by an American newspaper with close links to the US Air Force.

According to a former US Strategic Air Command officer, orders came down to keep "nukes" out of the records. Officially they did not exist.

SOURCE: CND, 162 Holloway Road, London N78dq, Uk

Do People Want Nuclear Power? Mo Way! Saw the Residents of Maki in Japan

A referendum was held on August 4 in Maki town, 25 km Southwest of Ni-gata City (Ni-gata Prefecture, mid-north Japan), in which over 60% of the voters said "No!" to the proposed construction of a four-unit nuclear power station in the town. A shocking blow not only to the Tohoku Electric Power Co., but to the central government as well.

Although this referendum does not legally bind the local and national administrations, the mayor of Maki town, Mr. Sasaguchi, had stated before the referendum that the municipal government would respect the result of the poll. In a press conference after the tally of the votes, Mayor Sasaguchi said the town would not sell the disputed piece of land to the electric company. This definitely means that there would be no Maki nuclear power station. Although Tohoku Electric has already 97% of the land it needs to start constructing on public land in question which is centrally located in the intended site.

The plan to build an 825-MW boiling water reactor (BWR) in Maki, which was first proposed in 1969, has been on hold since 1983 precisely because of the great difficulty Tohoku Electric has encountered in buying the necessary land for the site. There were 12,478 votes against the NPS proposal, with only 7,904 in favour. (118 votes were invalid.) Despite the rainy weather, as much as 88.29% of the electorate voted in the poll, showing the strong interest amongst residents on the issue.

This is the very first time in Japan that local residents were directly consulted if they want a nuclear plant in their backyard. The result

inevitably affected the national nuclear energy policy.

"I doubt if the voters really understood the necessity and safety of the atomic energy, was the insulting remark of a pro-nuke town councillor, upset by the referendum result. Given the politically conservative background of Maki town, and despite the corrupt practices on the part of the utility (backed up by the Agency of National Resources and Energy), the people clearly expressed their opinion, fulfilling their responsibility to future generations.

Three other towns/cities in Japan enacted N-plant Referendum Act in order to settle siting disputes. But actual polls have been postponed. The Maki result may have significant influence on the political climate in these localities.

The Ministry of International Trade and Industry (MITI) and the

subordinate Natural Resources and Energy Agency say the nuclear energy policy must continue as it is a national policy in the national interest and must take precedence over local interest. In a bid to promote construction of more nuclear reactors, MITI said on August 23 it would increase subsidies to local governments which host nuclear power plants. "In recent years it has become increasingly difficult to obtain land to build nuclear power plants," a MITI official said. "It is vital to gain local understanding." Annual subsidies to local governments with nuclear power plants are to be raised to 80 million yen (US \$ 740,000) per one million kilowatts. Under the current system, only economically poor areas receive subsidies of 40 million yen (US \$ 370,000) per nuclear reactor, on condition that the reactors have been operating for more than 15 years.

Source: *Wise News Comm.* 457

The "We Bring Good Things to Life" People Try to Kill Unfavourable News

Not only Indian politicians like to muzzle the press; large multinational corporations so conscious of their image are equally inclined. The US power giant General Electric (GE) whose motto is: "We bring good things to life" announced on 28 February 1996 its plan to kill its Advanced Light Water Reactor (ALWR) programme, saying that "extensive evaluations of the market competitiveness of a 600 MWe size ALWR have not established the commercial viability of these designs." GE quickly realised what it had done and tried to limit the damage by saying that the company had **not** intended to suggest that there was no commercial niche for other 600 MW ALWR's and acknowledged that the announcement made it look like GE was "taking a poke at Westinghouse". GE was so concerned about the implications that it offered on 28 February to pay for the cost of *Nucleonics Week's* pulling back and reprinting of all copies of the February 29 issue of the newsletter, with the phrase reworded so that only 600 MW Boiling Water Reactors of GE design would be implicated by the GE market analyses. *Nucleonics Week* declined the offer.

(*Nucleonics Week*, March 7, 1996)

Despite claims of Electricite de France (EdF)

DRENCH ELECTRICITY EXPORTS

of making profits on the export of electricity, the opposite is true. A critical report by the French energy consultancy INESTENE states that EdF should freeze exports of electricity and abandon construction of new nuclear plants. That would be less costly to the country than continuing electricity exports. INESTENE estimates that EdE's export business is losing the company at least Ffr5 billion (\$958 million) per year.

Export tariffs are lower than prices for the French industry. Over the past five years, the average export price varied from Ffr0.19 to Ffr0.227 per kilowatt-hour (KWh) and thus was less than half the average EdF tariff (Ffr0.44). The average electricity export price is also less than the full cost of a French nuclear KWh, which is Ffr0.2275 in 1995 currency. This is a conservative estimate of the nuclear KWh price, because it is lower than a reference price calculated by International Energy Agency (IEA) methods. The cost of exporting electricity also exceeds the revenues received for the exported KWh's. According to the most conservative models of INESTENE, the annual balance of costs for exports show an economic loss of Ffr5 billion. Other less optimistic estimates show a total loss for the country of Ffr10-35 billion. The emerging conclusion is that exporting electricity can never be profitable in the long term. The report contradicts the belief that given France's overcapacity of 11,000 MW, it is less costly to keep existing power plants working than mothballing them. Freezing the

THE RED BOOK IS OUT AND THE BLACKEST ENTREE REFERS TO INDIA

URANIUM 1995: Resources, Production and Demand, Paris 1996, 362 pp. ISBN 92-64-14875-2; Price about US\$ 80.

The book is published every other year and contains statistical data on uranium ore deposits and their exploration, uranium production, and reactor-related uranium requirements from 23 of the 25 uranium-producing countries of the world. The most remarkable change, compared to earlier editions of the book, is the inclusion of a paragraph on the environmental aspects of uranium production, in the general introduction, as well as in each national report.

But, the result of this new effort is rather disappointing: Only a few countries give an overview of the environmental impacts of the existing and former uranium mining operations, and how they are going to deal with them. Most countries present only a few rather general considerations, or simply describe, how environmental aspects are considered during the licensing process for new projects. One national report even states "There are no environmental issues related to existing uranium mines" (India), while many others simply omit the topic.



construction of the four nuclear plants (two at Chooz and two at Civaux), which cost more than Ffr40 billion, saves EdF an expenditure of Ffr3.4 billion.

Furthermore, INESTENE concludes that a "significant part of the exported KWh's must be attributed to fossil fuel sources". In 1994, 40% of the exports to the UK came from fossil fuel plants. The final analysts

of the report: "EdF's electricity exports are not profitable either for the economy in general or for the French consumer. The export increases physical and financial risks as well as environmental damage. For the importing countries it is a costly solution for the consumer, a disregard for opinions of citizens and trade sector that is secretive and non-responding to market rules." By the way, the French government delayed the publication of another critical report, an IEA study on the French energy sector. The SEA concludes in this report that France is too dependant on nuclear energy.

Source: Power in Europe, 31 May 1996, issue 225, p. 1,2,13

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from the Guys Who Gave Us Chernobyl: A Now Offering
Coming Soon to a Coast Near You

WORLD'S FIRST FLOATING NUCLEAR PLANT

After years of financial delay, construction of the world's first floating nuclear power plant is underway in Russia. Engineers hope to have it ready to operate by 2001, a prospect that fills environmentalists with horror but has Russia looking south for potential buyers. Russia has long had plans to build a series of small floating nuclear power plants for use in remote regions which are not connected to the national grid, or to replace thermal nuclear power plants that have grown too expensive because of high fuel transportation costs. Andrei Gagarinsky, vice president of the Russian Nuclear Society and head of international relations at the Kurchatov Institute in Moscow, claims: "Russia will need at least 15 small, low-power floating nuclear power plants. They will be used in inaccessible regions of the Far East, extreme North, Altay Territory and the Kola Peninsula." He noted that Russia is the world leader in small nuclear power plant production and sees these plants as potential export products, especially to developing countries. He added that Indonesia, South Korea, China, and Vietnam have all expressed interest-

But environmentalists are not convinced. "We know about the quality of the Russian fleet's nuclear reactors. A Komsomolet nuclear submarine is still located at the bottom of the North Sea," says Vladimir Sliviak of the Socio-Ecological Union/Antinuclear Campaign in Moscow. "The Chernobyl explosion blew the reactor lid, a 2,000-ton block of concrete, into the air. These vessels will not even have that sort of protection. This

must pose a clear risk to both the marine and land environment."

The floating plant is essentially a ship with two small pressurized water reactors (PWRs) known as KLT-40s, adapted from those used to power Russia's nuclear icebreakers. The KLT-40 enhanced safety PWR, designed by OKBM Experimental Design Bureau of Mechanical Engineering in Nizhny Novgorod, has been used for over 20 years to power the USSR's seven nuclear icebreakers as well as nuclear-powered cargo ships. The reactors each have a power output of 35-50 megawatts, giving the plant an overall capacity of up to 100 MW of power or 50 MW plus power-generating heat. Besides the OKBM, the Kurchatov Institute in Moscow and the Aisberg Design Bureau in St. Petersburg were involved in the design of the plant which is now being built at the Baltisky Shipyard in St. Petersburg.

If everything is going according to plan, the first plant will be sited at the Arctic seaport of Pivek in the Chukotka Peninsula in the far northeast. It will be operated by 40-50 people working in shifts and has a design life of around 40 years. Spent fuel and wastes will be stored on board and every 13 years it will be towed 4,000 kilometers through Arctic seas to Murmansk in the Kola peninsula in Russia's northwest

for maintenance and reloading with fresh fuel. During this procedure, which will take around a year, a substitute floating plant will be put in place. The floating reactor is expected to cost \$254 million and will take six years to build.

According to Alexander Poloushkin, director general of the Malaya Energetika Research and Production Association: "The plant has reliable protection systems to safeguard against all possible risks, including sinking, capsizing and even an aircraft crashing on top of it," he says. "It won't pollute the area with any nuclear waste because it will be stored on board." (nice try!)

Source and Contact: Vladimir Sliviak, International Nuclear Campaigner, Socio-Ecological Union Campaign, PO Box 211, 121019 Moscow, Russia.

Letter Box

I visit Mysore city quite often and recently while miking with environmental groups there, I was surprised to know that Government of India has established an industrial unit under the name of Rare Materials Plant which covertly processes nuclear material for both "peaceful" and "defence" needs. I have also been informed that citizens contacting the management regarding the true nature of the plant are given the silent treatment, this makes the existence of the unit all the more suspicious and extremely dangerous to human habitats in the vicinity from a health point of view.

Any information from individuals and groups will be most useful and can be sent directly to me.

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Armenia in a Bind

No Alternative But Nuclear

Nucleocrats in India have changed their tune. In a spirit of sweet reasonableness they are even willing to admit that nuclear power has not delivered on its past rosy promises. But, they add, despite this miserable past, we have no alternative but to develop it so that its contribution to the nation's electricity supply becomes 15 to 20 percent during the next 20 to 25 years, since the demand for power is skyrocketing and the coal quality is so bad. The following article, describes the devil and the deep blue sea choice facing the people of Armenia, because of an unhesitating acceptance of no alternative but nuclear power hind of thinking.

For six years Armenians lived in the semi-darkness of the Middle Ages. Beginning in 1989, these 3.7 million people in the southern Caucasus survived without adequate heat, transportation, or medical care. There were only endless candlelit evenings with no television or music. "You lived in the Sabbath all year long," a Jewish friend commented.

The crisis was precipitated by a devastating earthquake and the closure of Armenia's only nuclear power plant. It was compounded by the break-up of the Soviet Union and an economic blockade that cut the country off from other energy sources. The power shortage left the post-Soviet government with a stark choice: nuclear power or continued crisis.

For those living through the dark years, the risks associated with nuclear power were overshadowed by the hardship of this period. The reopening of the power plant, which occurred last fall, could never be merely a technical question.

The earthquake of December 7, 1988, measured 6.7 on the Richter scale. It took the lives of 30,000 people, levelled two cities and 55 villages, and destroyed one-tenth of the country's industry. It also shook faith in the safety of Armenia's only nuclear power plant.

Medzamor, which sits in an unsafe seismic zone 30 miles south of the capital of Yerevan and 60 miles from where the quack hit.

The plant, which consists of two VVER 440/270 reactors (modified from VVER 440/230s), had one of the best safety records of Soviet-style reactors. Unit 1 came on line in 1976, and Unit 2 in 1980. They provided Armenia with a surplus of energy, which was exported to other parts of the Soviet Union and Turkey.

Even though the plant experienced no damage and was designed to withstand earthquake of up to 8.0, a large movement led by the country's Green Union called for its closure amid safety concerns and anti-Soviet sentiment. Armenia's growing self-determination movement focused on the potentially risky power plant as a symbol of Soviet domination and exploitation.

Alter heated disputes among politicians, scientists, and the Greens, the Supreme Soviet, the highest government body in the then Soviet republic of Armenia, agreed to shut it down. Between January and March 1989, the two reactors went off line. Nearly 40 percent of the country's total energy supply was no longer available.

The break-up of the Soviet Union, following closely on the heels of the plant closure, further destabilised the country. While many problems were common to all former Soviet republics, the era of independence began particularly unfavourably for Armenia, the smallest among the newly independent nations. Since 1989 Armenia has been locked in a bloody dispute with neighbouring Azerbaijan over the territory of the Nagorno-Karabakh, an enclave of Armenia deemed part of Azerbaijan by Josef Stalin in 1922. The ongoing war monopolised the human and financial resources necessary to build an independent post-Soviet infrastructure.

This once scientifically and culturally advanced country also was subjected to a total blockade related to the war by Azerbaijan and Turkey. Armenia's only remaining connection to the outside world was through its northern neighbour, Georgia. But during the fighting, the railway lines and gas pipelines that pass through Georgia were permanently destroyed by Azeris living in that country. Georgia, which did not investigate this terrorism, was believed to be pilfering the Armenian share of gas sent from Turkmenistan. With barricades on all sides, even the delivery of humanitarian aid, now completely dependent on air shipment, was slowed.

Six years

And so the crisis began. Industry slowed, factories shut down, and office workers were laid off. Even ambulance service was halted because of a lack of gasoline. People passed the winters in their apartments, where room temperatures hovered close to freezing. Deprived of their jobs, they had only two reasons to go out-to get fuel and food.

Under the blockade. Armenia could provide for only one-fourth of its daily bread. This brought long and excruciating bread lines, and often the military was required to keep order. Eventually a voucher rationing system was enforced, providing a daily ration of 8.8 ounces per person. "Every day pupils in the school are fainting," said Hasmik Sargisyan, the director of studies at a secondary school in Yerevan. "The teachers used to keep sandwiches in their bags for emergency cases."

During this period people received only one to two hours of electricity a day, and their lives were defined by it. "We had to manage to do everything in two hours--to cook, to bathe, to wash, to watch TV," said Theresa Arazian, a professor of musicology at the time was spent planning how to get candles and the fuel to fire wood stoves and kerosene lamps.

After the first two years, the government became more efficient in its use of energy and more became available for necessities including hospitals and factories. But people rigged up cable known as "left lines" to siphon off electricity from these high-priority users to augment their two-hours-a-day allowance. Some even attached the left lines to unused metal bed frames, heating them like giant radiators. According to Armenerg, the government's electricity agency, 40 percent of the electricity generated was used illegally. People joked

that Armenia's President Levon Ter-Petrosian promised to provide the whole nation with "left lines."

The only outside help with heat came from a U.S. humanitarian program called "Winter Warmth," which provided kerosene to Armenia from 1992. Some people, however, were reluctant to use this fuel, as Armenian doctors warned that the fumes could be harmful to children.

Many people left the country. "I couldn't survive another winter in Armenia. This was sheer hell," said David Babayan, a writer and actor who immigrated to Moscow. According to the U.N. Development Program, 676,000 people--or about one fifth of the population--left during this period, many settling in Russia, the United States, or Israel. Much of the country's professional and artistic elite were part of this exodus. But millions of others remained.

The woodcutters

At first chopping down city trees for fuel was considered shameful, and the main concern of woodcutters was to go unnoticed. At night, armed with axes and saws, they chopped the trees they had targeted during the day.

Very soon it was commonplace and no longer considered a dishonourable deed. The soot billowing from round holes in apartment windows was a sign of success. "I can plant tree in the spring, but I can't bring back my kids," said my neighbour, the father of five children.

People started with the tree in their gardens and ended up with those decorating the House of Parliament. The Ministry of Ecology estimates that 800,000 trees were chopped down throughout the country in the first two winters. After intensive wood cutting the cities seemed bald. "Good bye, and

good luck in wood cutting," a television showman would say at the end of the programme. Trees became harder and harder to find. Today there is a memorial in Yerevan, a sculpture of a tree, erected as a reminder of the "Genocide of Nature."

Getting around

The streets of Yerevan were filled with pedestrians. People walked and drove by instinct, without the aid of street or traffic lights, which were turned on for only two days a year at Christmas time.

Why get into a situation where you are faced with two stark choices: either have the sword of nuclear disaster hanging over you or else freeze in the dark. A non-nuclear sustainable energy future if planned carefully in advance would avoid both pitfalls

The energy shortage also paralysed public transportation. Often trolleys would be stalled on hills when the electricity was cut off. At these times male passengers would get out and push the trolley to the top, and then, like kids on a roller coaster, jump back in to enjoy the ride. When the rare trolley did get electricity, it carried many times more people than it could comfortably hold. And trolley doors never closed as dozens of people hung out of them in acrobatic positions.

Others chose to walk rather than stand in claustrophobic trolleys. With many extra pedestrians came extra falls on icy sidewalks. A common joke in Yerevan was that Armenians had become better at falling than Charlie Chaplin or Buster Kcaton.

At the zoo

It was a sad day at the Yerevan Zoo when its only elephant, Vova, died in 1993. "The specialists failed to give a precise cause—cold, malnutrition, bad living conditions," said Hripsime Brutian of the zoo's publicity department.

The inhabitants of the zoo were kept in their winter houses, without electricity. "The animals have been in complete darkness for five months and will live [this way] another month until the winter is over," Karo Mandalyan, the zoo's manager, explained. Members of the zoo's staff did what they could. Many brought food from their homes. The snake keeper even took the snakes in their glass containers to his apartment where he could keep them warm with a wood heater. When the elephant died, it was used to feed the other animals.

"Only this winter, we lost 64 big and small animals: zebras, tigers, birds, wolves, and sheep—all from cold and hunger," said the manager. "Every morning I come to the zoo with the fear in my heart to see another dead animal." A visiting journalist filming the zoo for Germany's Stern Television said, "Damm, it was a concentration camp for animals."

A decision

As the energy crisis lingered with no end in sight, the Armenian government announced in April 1993 that it would restart one of the two units at Medzamor as the only viable short-term solution.

Armenian citizens were fully behind the decision, but they were alone in the view. All of the country's neighbours held protests, questioning the safety of the reactor. Turkey, which supported Azerbaijan in its war with Armenia, even offered at one point to lift its

blockade if Armenia would keep the reactor off line.

The West also opposed Armenia's decision, and from the start refused to provide technical assistance or guidance for the plant's reactivation, arguing that because the plant was in a zone of high seismic activity, it could never meet safety standards. "We wanted to do all we could to prevent its restart," said a representative of the European Bank for Reconstruction and Development's Nuclear Safety Account (International Herald Tribune, October 25, 1995).

Armenian officials attributed Western objections to their interest in securing contracts for new power plants for Western businesses. "This is a struggle for the market," Vanik Nersisyan, deputy head of Armenia's Department of Atomic Energy, told the International Herald Tribune. "This is an issue of the employment of the Western population." Compared to building new plants, little money could be made in assisting in the upgrade of Medzamor. Armenian plants were not amongst those designated for Western 'help' for 11 other WERs currently operating in Bulgaria and Russia.

Spurned by Western authorities, the Armenian government turned to Russia for help. Russia provided Armenia with loans to upgrade the plant, including the addition of reinforcements against seismic activity and the construction of a new cooling-water lake.

When it became clear that Armenia would go ahead with or without Western assistance, equipment also was provided by France, Germany, Bulgaria, and other European countries. According to the April 6, 1996, *New Scientist*, some countries were changing their stand on even on the more dangerous RBMK reactors like those at Chernobyl. Again, some interpreted the change as a means of

helping Western businesses benefit in the post-Soviet marketplace.

"The closure of the reactors would mean that Western nuclear corporations would lose potentially valuable contracts for fitting safety equipment," said German Environment Minister Angela Merkel.

Between 1994 and 1995, more than 500 tons of equipment was airlifted to Medzamor, and 800 upgrades were performed to improve the reactor's safety. After frequently sending World Association of Nuclear Operators and International Atomic Energy Agency (IAEA) inspectors to Medzamor, the IAEA concluded in 1994 that "the plant is safe and there are no principal obstacles for the restart."

Ironically, when Medzamor's Unit 2 was turned on in November 5, 1995, it was greeted with the same euphoria that attended the decision to turn it off in 1989. The plant ran at 92 percent capacity during the winter, according to the government's nuclear regulatory agency. It produce enough electricity to satisfy 25 percent of the needs of the country's population and industry.

Armenians are gradually recovering from the dark experience of the past years. They are coming round from the absurdity under which they lived, and getting back to a normal life—or as normal as life can be in the midst of war and a blockade. Today in Armenia we no longer hear children's hoorays when electricity is turned on. It is an accepted part of life, and these cheers are once again reserved for fireworks and Christmas trees

But recovery was built on nuclear energy—a necessary short-term compromise for a country that has no other reliable source of power available.

*Source: Bulletin of Atomic Scientists
July/August 1996*

Bangladesh Hunts for Investors for Nuclear Power Plant

The Bangladeshi government is shortlisting investors willing to fund the Rooppur Nuclear Power Plant. The Bangladesh Atomic Energy Commission (BAEC) is considering private firms along with government agencies for the Rooppur plant as the government is now encouraging the private sector to fund such projects. The IAEA is willing to provide consultancy in the installation and operation of the plant. Since years, Bangladesh officials are advocates of nuclear technology and nuclear energy. In 1987, the head of the Bangladesh delegation to the United Nations

conference for the promotion of international cooperation in the peaceful uses of nuclear energy, Ataul Karim said: "Bangladesh is convinced that if used in a planned manner with adequate care and caution, the nuclear technology can usher in a new era of progress and prosperity for the developing world ...

Already *in* the mid-sixties, before Bangladesh became independence from Pakistan (December 1971), there were talks of constructing a 125MW nuclear reactor at Itoopur. Suppliers included first USA,

then Canada, then the Soviet Union and when that didn't succeed, France. Even Saudi Arabia was (in 1981) said to be willing to finance the whole project. But it didn't work out. Currently, one 3MW research reactor is in operation in Bangladesh. On 14 Sept. 1986, the Triga Mark II (supplied by the US company GA Technologies) became critical at Rooppur.

Sources: Asian Energy News, April 1996/ Statement by Mr. A. H. S. Ataul Karim, March 27, 1987/ Jahrbuch der Atomwirtschaft 1981 / New Scientist (UK), 8 Oct. 1981

Deinococcus Radiodurans Shall Inherit the Earth

IT IS almost supernatural. *Deinococcus radiodurans*, a nondescript bacterium first isolated in 1956 from a spoiled tin of meat, can survive several thousand times the dose of radiation that would kill humans.

This has puzzled biologists for years, as no organism could have been exposed to such intense radiation under natural circumstances. But two bacteriologists in the US have now shown that *D. radiodurans*'s remarkable resistance to radiation is almost certainly a by-product of its approach to surviving dehydration. Meanwhile, other researchers may have worked out how *D. radiodurans* defies death.

When it comes to withstanding radiation, the five known members of the family *Deinococaceae* have no rivals. Each bacterium carries several copies of its single loop-shaped chromosome. If exposed to between 10 and 15 kilograys of radiation over several hours, each

copy sustains around 120 breaks that cut through both strands of its DNA. Other bacteria die if their chromosomes suffer just two or three such breaks, but *D. radiodurans* can repair its shattered chromosomes. "There's nothing else on Earth that can endure that kind of damage," says John Batou Rouge.

Battista and his colleague Valerie Mattimore realized that *D. radiodurans*'s extraordinary DNA repair system must have evolved to mend DNA torn apart by some other extreme environmental stress. In a paper to be published in the *Journal of Bacteriology*, the researchers describe how they created mutant *D. radiodurans* by treating the bacteria with a chemical that 41 of these mutants had lost their ability to withstand radiation, and every one was also unable to survive desiccation. The other mutants, however, recovered after drying out. When the researchers examined the chromo-

somes of desiccated bacteria, they looked just as if they had been blasted by radiation.

The habitat in which *D. radiodurans* and its cousins evolved is unknown. They have been isolated from animal faces, Swedish underwear and weathered Antarctic granite. But Battista is sure that, like many free-living bacteria, they must have periodically endured periods of dehydration.

So why have other bacteria not evolved resistance to radiation? Battista says that most survive desiccation as spores, *in* which their DNA is wrapped *in* protective proteins. "Spores evolved to prevent DNA damage," says Battista. "*Deinococcus*, on the other hand, has hyped up DNA repair."

After dehydration, the bacterium has to rebuild a copy of its chromosome from hundreds of fragments. Kenneth Minton and Michael Daly of the Uniformed Services Univer-

sity of the Health Sciences near Washington DC have found that a key player in the repair job is an enzyme called RecA. This cuts and splices together overlapping fragments of DNA with partially matching sequences, and so can rebuild a chromosome from random fragments.

In another paper that will appear in the *Journal of Bacteriology*, Minton and Daly report that deleting the gene for RecA in *D. radiodurans* destroys its radiation resistance. Replacing it with equivalent gene from a bacterium called *Shigella Flexneri* did not restore *D. radiodurans*'s ability to repair its DNA. This suggests that *D. radiodurans*'s RecA is usually efficient.

However, *D. radiodurans* repairs its chromosomes far more quickly than can be explained by the presence of one "souped-up" enzyme. Minton and Daly says that the pieces of radiation-damage chromosome must be held in their correct order to facilitate rapid repair. They treated *D. radiodurans* cells with a stain that illuminates DNA and found that its DNA is gathered into packets, as if the copies of its chromosome loops are stacked up. "A lot of these packets look like doughnuts," says Daly.

Minton's and Daly's favoured theory, which they outlined in *Science* (Vol 270, p 1318), is that the chromosomes are anchored held alongside. These links are known as Holliday junctions. In higher animals,

they normally occur during the cell divisions that from sperm and eggs, as an intermediate stage in the "crossing over, mechanism used to shuffle DNA between repaired chromosomes.

Microbiologists want to use bacteria to clean up sites contaminated with chemical and radioactive wastes. It should be possible, says Daly, to take genes that allow bacteria such as *Pseudomonas* to break down toxic chemicals and insert them into *D. radiodurans*. The result would be toxin-munching, radiation-resistance superbug.

*Peter Aldons New Scientist 9
December 1995*

A Technology Full off Unpleasant Surprises

The first meltdown experiment at the Phebus nuclear reactor in Cadarache, France, has come up with unexpected results. Part of the findings of the experiment have been released by the European Community, which funds 30 percent (900 million FF.) of the Phebus project. The full report on the first test is expected to be finished sometime in 1996, but, for commercial reasons, will not be released to the public.

The Phebus experiments consist of six meltdown in the core of the Phebus reactor in the nuclear research centre Cadarache. The goal is to find out whether computer models for meltdown accidents in nuclear reactors are still valid or corrections to these models have to be made.

It took a long time before the first meltdown start on December 2, 1993, as the French nuclear safety authority DSIN worried about a possible steam-fuel clad-

ding reaction. Explosive hydrogen gas is formed in such a reaction, which starts at a temperature of 1200 degree Celsius. Meltdown was finally achieved when the temperature reached 2840°C. The test was interrupted when the fuel threatened to melt through the first barrier. Some days later, a defective safety valve burst, releasing 5 mill Curies of radioactive gas into the air.

One the unexpected results of the first Phebus experiment was that the fuel melted much earlier- It started melting at a power capacity of 50 kilowatt instead of the expected 90 kilowatt. Another unexpected result was that the melting process took place in a bigger core area. The unexpected results gave rise to uncertainties about the project for a time and have led to the postponement of the second meltdown experiment from the original target date of January 1995 to March 1996.

A Dutch physicist involved on the Phebus project believes that the construction of the Phebus reactor itself could be the very reason for the unexpected results. According to him, the meltdown occurred earlier than expected because the transport of heat from the core was too low. He doesn't think that international computer models now often used, like the ones from the Sandia National Laboratories (US), will be changed. "The core could melt two times faster than expected. But WHEN it melts, it doesn't really matter if it goes twice as quickly than expected."

Nuclear power plant owners and others in the nuclear industry fear that the Phebus experiments may provide new insights on meltdown risks which could lead to stronger safety requirements for nuclear plants. Stricter requirements would of course mean more expensive safety measures.

Unlike the first Phebus test, which was conducted with unirradiated fuel; the March 1996 test will be conducted with irradiated fuel, which will come from the closed Belgian BR-3 reactor. The test will be used to gain more in-

sights on the melting of embrittled fuel and the spreading of radioactive materials from it. The project is slated to be completed around 2002, unless new uncertainties arise.

Source: Volkskrant (NL), 3 Febr, 1996; PT Weekblad (NL), 17 Dec. 1993; Standaard (Bel), 4 Dec. 1993.

X-Rays: Unnecessary Overexaminations can Kill

Russia tries to reduce irradiation deaths

One of the good measures which the previous chairman of the Atomic Energy Regulatory Board took was to try and regulate the mushrooming growth of X-ray clinics with no proper equipment, procedures or shielding of technicians and passers-by alike. However, this is a gigantic task and needs far greater effort than has been directed at it till now.

Russian citizens are to be issued with "radiation passports" to try to reduce the number of deaths due to overirradiation. In Moscow alone 8000 people die every year of cancer, radiation sickness, or reduced immunity directly related to too many x ray examinations, according to Dr Roman Stavitsky, a senior medical officer who heads a laboratory investigating the subject.

Dr Stavitsky blamed the thousands of deaths_which include deaths due to diseases related to cancer in subsequent generations_on faulty equipment, outdated attitudes to health care, inadequate training in hospitals and x ray departments, and inadequate shielding from radiation. Russians undergoing routine medical checks are exposed to radiation levels up to three times higher than those used in "civilised countries," he claimed. There are not enough health experts to cope.

When Russia was part of the Soviet Union all adults had regular lung x ray examinations to screen for tuberculosis. Although this practice was stopped a few years ago, over half of Moscow's adult population had an x ray examination of some kind last year.

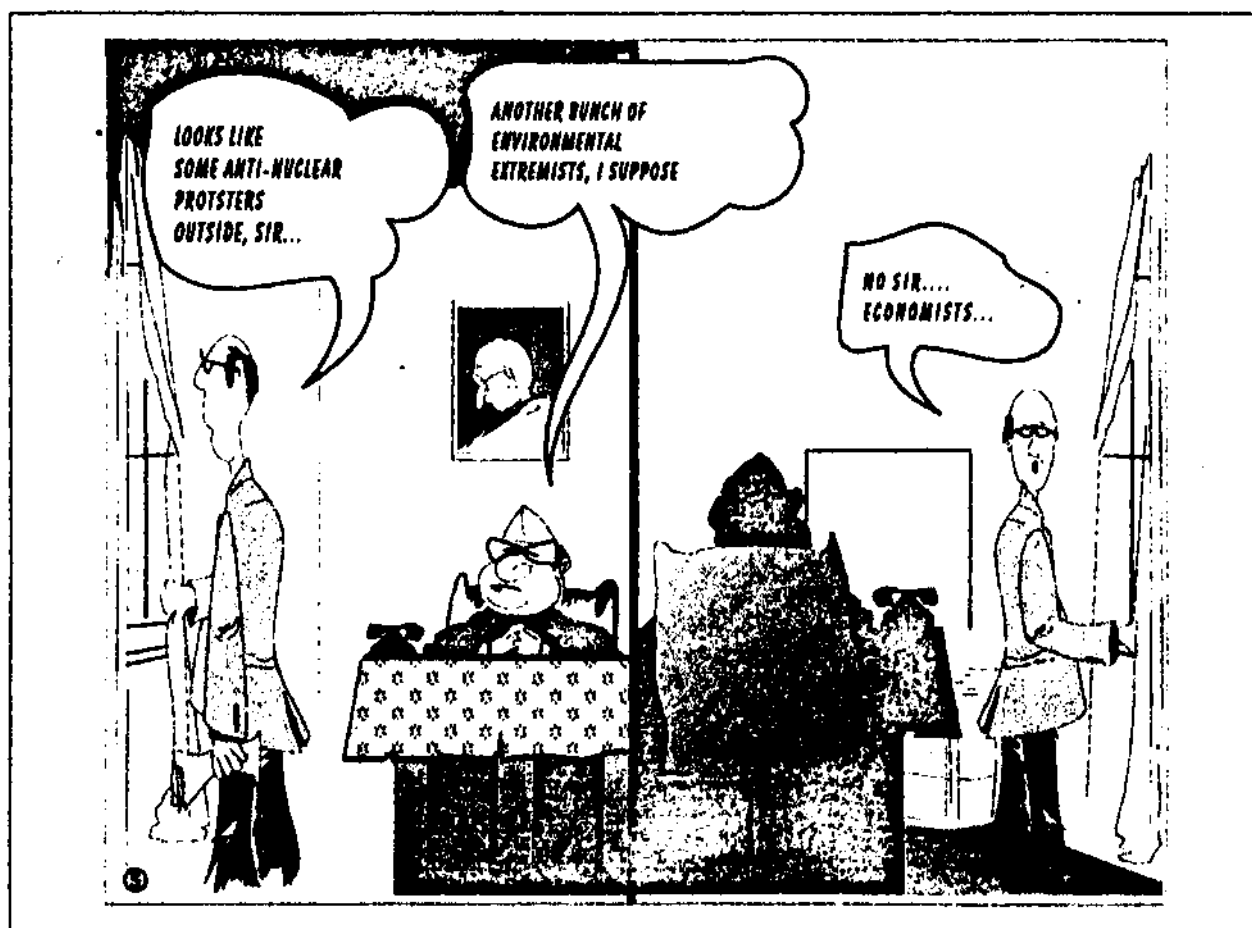
Officials in the city health department say that a new health care system introduced in 1992 encourages x ray examinations and that the number of x ray procedures and examinations that are unnecessary has doubled.

Sergei Okhrimenko, deputy head of a city department that checks radiation sources, said, "We consider this a big problem, all the more so since it happens in a country which

suffered the Chernobyl catastrophe."

The passports are the brainchild of Moscow's senior radiologist, Yury Varshavskiy who plans to set up a new diagnostic and co-ordinating centre, which would enable people to keep a check on their exposure to x rays.

Miranda Ingram, Moscow bureau chief, The European British Medical Journal



A Doctor's View of French Polynesia

The land is like our mother. People come from the land.
We must always respect our mother, not explode bombs in her belly
Our good way of life comes from the land.
Destruction of land will lead to destruction of life.

**JACQUES IHORAI, president,
Evangelical Church of French Polynesia**

Nuclear testing ruined the country," says a French doctor. We met on the docks of Tahiti, watching Greenpeace's ship, Rainbow Warrior, depart for the atoll of Mururoa. "Not only by contamination of the environment with nuclear fallout or leakage of the residue in the bottom of the atoll, but far more by disrupting the social harmony of the country," he continues. "The country was self sufficient before the testing started; people subsisted on farming and fishing. Nowadays the state is entirely dependent on France. Imports exceed exports tenfold; it is an artificial state: approximately 15 percent of the population work as civil servants. Migration, loss of cultural values, degradation of agriculture, change in eating habits, prostitution, alcoholism, and mental illnesses are all the result of this. This country is addicted to France. Since the moratorium on the testing, the people have been forced to think of a future without France. Resuming the testing is like giving an addict who recently stopped using drugs another shot. France has the obligation to leave behind a state that is self sufficient and not a wreck with a long term legacy of nuclear waste, I can show you files of patients who died of radiation, but I guess you are more interested in public health aspects. Well, the cancer register you might look for doesn't exist: not kept, or hidden, who knows? Anyway, inaccessible for us. Don't forget that until 1984 most practising doctors

here were military people. It is no coincidence that the doctor supervising the atolls of Tuamotu, where the test site Mururoa is situated, is still a military doctor."

French Polynesia is an archipelago of about 130 islands, situated in the Pacific halfway between Australia and South America (map). The territory covers an area as big as Europe. Although its population is only 200 000, the country is well known to the world, mostly for its paradise-like scenery. The crew of the Bounty simply refused to sail on and settled on one of the islands. Who has not dreamt of retiring on a distant atoll, inhabited only by some friendly natives, subsisting on fish and coconuts? Jacques Chirac's announcement of the resumption of nuclear testing on the atolls of Mururoa and Fangaiuafa, in the extreme south east of the archipelago, has stirred not only the archipelago but also the world.

As an overseas territory, French Polynesia has an autonomous government, but it depends on France for defence, justice, finances, and foreign affairs. The islands of the archipelago have a volcanic origin. Tahiti, on which half the population lives, is the largest. The smaller islands are atolls; the volcano sank and coral was deposited on top. This coral is visible as a rim above sea level, surrounding the inner lagoon. After Algerian independence forced France to stop nuclear testing there, the French

decided that the Pacific was the most suitable place to continue, conducting 44 atmospheric tests up to 1976. Thereafter they performed 110 underground tests, drilling boreholes 800 metres into the basalt of the volcano. It is presumed that the nuclear waste after the blast remains safe in the basalt and does not migrate into the environment. Ironically, Mururoa means place of the great secret in the local language.

A child without an anus

We decided to visit the country to assess the effects of the testing on the health of the population and to see whether this necessitated a humanitarian response. Papeete, the capital, is a small town of about 40 000 inhabitants. It is difficult to keep a low profile. In no time at all the journalists arc alter us. Rumours pop up: we have been sent by the French government; we have boarded the Greenpeace ship Rainbow Warrior to sail to Mururoa. On the street I speak to a woman; she tells me that her child was born without an anus.. "The child was operated in France, but I never got the results of the investigations. They keep the diagnosis secret, they hide the results, sir. There are more children born without an anus," she says. I'm told by another woman that there are 15 000 handicapped people in the country. I try to, calculate a figure for a quick reference; but who defines handicapped? "We can organise for you to meet people who still

suffer from skin diseases, body pains, children with short arms, all due to the testing," a delegate of the local union tells me. I'm not really interested at this stage in a parable of incurable patients. It seems important to obtain objective data but it is difficult to break through the hysteria of the information.

The high commissioner promises openness; a visit to the site is, however, impossible at this stage. He hopes we understand. He explains some rumours. Radiation is higher in Europe; Australia is nearer to China (which also does nuclear tests) than to Mururoa; and there have never been illegal burials in France. In no time a couple of meetings with local authorities are scheduled. We visit the department of public health and ask directly about the rumours, is the incidence of cancer higher due to the testing? Are evacuations to Paris done secretly? Are there more congenital malformations than in other countries?

The cancer issue would seem easy to answer, but not in Polynesia. "The register started in 1985; before that time no systematic collection of data existed," the official tells us. "But, no problem, if there would be more cancer due to radiation we would find out now, because it has a time lag of decades before cancers develop. Cancer ranks number two on the top five mortality but one should not forget that the population grows older; now the life expectancy at birth is 66 years for men and 72 for women. Furthermore, the lifestyle has changed completely." Indeed the number of obese people in the street is striking. There is no register for congenital malformations in the country_difficult to believe for a country in which nearly all women deliver in hospital. If data for the general population are lacking, what about data for the groups at risk: the site workers, in thousands; the military; the people living on nearby atolls who have sup-

posedly been exposed to high nuclear fallout during the atmospheric tests? "The surveillance of the workers is the responsibility of the employer," states the official. Me cannot provide follow up on the issue. "The follow up of the people on the nearby atolls is difficult. There has been considerable migration, how to find the original group? it is too expensive and laborious. We have more pressing issues to address. Road accidents are the number one killer, especially among the youth. In fact we have the highest standardised number of deaths due to accidents in the world. We work hard and we have made progress, but we cannot do everything at once. We have made good progress with health over the last few years."

Indeed, an extensive network of health posts covers all atolls. Most of the atolls are connected by a direct telephone system; if necessary, referrals by plane can be made. The country has 300 doctors and in Papeete there is a referral hospital equipped up to European standards. It seems, however, that the costs of this system are not sustainable without outside help. The contrast of the high level of care and the embryonic stage of data collection for the population at risk is striking and makes one suspicious.

A clinician we speak to later explains that there is serious underreporting of the number of thyroid cancers. "Thyroid cancer is far more common than reported and we definitely see it more than in France. This is not necessarily related to radiation but may be caused by goitre. Goitre has a high prevalence in the area; it already appeared in Gaugin's paintings."

15 000 litres of coconut milk

The next day we visit the nuclear protection and safety institute. "Surveillance is done of the environment and the food chain for the

whole of Polynesia," the director explains to us. Later it turns out that they test food everywhere in Polynesia except for the test site. "The test site is not permanently inhabited and no food grows there," we are told. It still seems strange. We are oversaturated with figures. "One has to drink 15 000 litres of coconut milk from Tahiti to get the maximum intake of caesium 137." That seems difficult indeed. "The food with the highest radiation is being imported, Milk powder from Europe, contaminated after the Chernobyl incident, or mineral water with natural radiation yield the highest activity," he continues. The grays, curies, rems, and their modern successors sieverts and becquerels are all within reasonable limits.

Another representative walks in: "I have worked for over 20 years on the atoll and swum there everyday in the lagoon." We understand that the dose of radiation due to underground testing, as they measure it, is minimal. But has it ever been measured by independent scientists? The three independent studies to investigate the atoll that have been permitted by France have all suffered from the same restrictions: too little time, limited access, and insufficient provision of background data. And what is the long term outcome of the nuclear residue in the bottom of the atoll? It is difficult to imagine what is actually tested; is the hole definitely sealed off, why don't they test even deeper than the 1000 metres they reach now, do they work on the cavity left by the explosion, are all the test holes connected? The answer seems too simple to be true: "The load is sealed off by the process itself and that is it." The opinion of the officials on the follow up of the workers is also simple: "We have no right to check on people after they quit their job. The environment is surveyed and as long as the radiation is within limits, there is no need to check the people."

The military doctor we spoke to is a nuclear specialist and he too is convinced of the minimal effect of the testing on the environment. "The levels are so low that we have problems with the threshold limits of our detection equipment. No, the environment will not suffer; there are even plans to make a national park of Fangataufa_ the abundance of birds is striking." What about the risk of cancer for the workers? "The risk with such a low dose of radiation is not known, but difficult to imagine." he says. What about the follow up of the military? "There are only a dozen military people who received a maximum dose of 15 rem in one incident. Doctors, especially radiologists, obtain the most radiation in Polynesia."

Safe enough for the Cote d'Azur?

Not being able to visit Mururoa, we try to visit a nearby atoll. "Does the boat sail regularly?" we ask a man from Gambler. "Yes," he answers decidedly. "How often?" "Every month." "And returning?" The man looks puzzled by the question, He shrugs: "The next month of course." The journey is abandoned. The rally tour of officials has rendered useful information. The actual radiation from underground testing seems small. But all these figures are provided by the authorities. Why don't the authorities allow in depth research at the atoll by independent scientists? This could effectively counter all the hysteria. Greenpeace never got permission to measure directly around the atoll. Their flagship was blown up by the French secret service in 1985, leaving one crew member dead (and the two secret agents sentenced to jail for 1.0 years). Many Polynesians say "It* the testing is that safe, why don't the French do it at the Cote d'Azur?" Minimal radiation into the environment doesn't exclude all risk. In Chernobyl too the authorities would tell you that the risk was

zero. The risk of an accident can never be excluded, In 1985 the load exploded halfway in the shaft at 400 metres; in 1981 a typhoon hit the island, throwing a cement slab, and the nuclear waste that was stored underneath, into the lagoon. The outcome of the nuclear residue in the bottom of the atoll on the long term is unpredictable. Will it not leak and contaminate the environment?

The lack of follow up of the people at risk is a serious omission. I cannot state that all tests should be banned_ some people argue that the nuclear threat kept the post-war world in a peaceful balance. Minimal ethical standards should, however, be adhered to. Polynesians shoulder a heavy burden of the testing. In 30 years their society changed from a "subsistence paradise" to a money driven society dependent on France. Before, the inhabitants lived on fish; now croissants seem the staple food. This process has brought progress, but has it brought happiness? it is the moral obligation of the French government to pay attention to these aspects and invest in forming a stable society, instead of leaving behind_ along with the kilos of radioactive material in the soil_ a crippled society. Active follow up of workers and people being exposed to a

high level of nuclear fall out at the time of the atmospheric testing seems indicated. This is extremely laborious but not expensive compared with the actual testing. If the French insist on continuing the testing they should take full responsibility for the programme and do everything to protect the local population from the side effects of a show they never asked for.

Source: Hans Veeken, in British Medical Journal (1995) ;311:497-9

Subscription Information

*Rs. 30/- per year (6 issues) (within India)
U.S. \$ 15/-- per year or equivalent in other
currencies for airmail overseas.
lis. 500/- for life (only within India)*

Demand drafts should be drawn on the State Bank of India, Valod (Code: 0531) For cheques and drafts drawn on otherdrinks, please add lis 10/-
Subscriptions, donations and enquiries regarding circulation should be addressed to:

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Published by S.Gadekar for Sampoorna Kranti Vidyalaya and primed by him at The Parijat Printry, Ahmedabad.

PRINTED MATTER