



ANUMUKTI

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The Rehabilitation Grinder

Once upon a time, the Satpura mountains and _____ the Tapti valley which originates from these mountains were both covered with thick forests. Nowadays, one is lucky to see maybe a tree or two out here to remind one of the glory gone by. Of course, there are clumps of Eucalyptus trees from various "social forestry" schemes. Villages dot the farms in the river valley looking like raisins in a cake.

The Gandhi Mela, which is observed every year jointly in the three districts of south Gujarat was held this year at a small village called Khorda in Nizhar Taluka of Surat district. We had gone there on cycles with communal harmony as our theme. While returning, friends invited us to take a round about route and visit their homes. "It would get you in this area which is downwind from the Kakrapar Nuclear power plant. The road goes through some beautiful countryside. And you can see some of the only bits of jungles left in Gujarat." After such an invitation it was impossible for us to refuse.

Twenty years ago, a dam was built across Tapti at Ukai. The displaced people were "rehabilitated" on both banks of the river. In the old days before independence, this area belonged to the kingdom of Rajpipla. The raja had invited farmers to come and "settle the land." A number of rich absentee landlords from the coastal region of south Gujarat had accepted this invitation, levelled the land and got it 'farmed' by "halpatia"—poor farmers. After about half a century of this farming, the land is no longer very productive. Thus, these landlords are today happy to sell the land to the government for rehabilitation. It gives them adequate money as well as prestige. They are 'helping' to build the lifeline' of Gujarat

While the immediate neighbourhood is today totally devoid of forests, there are old growth forests still extant some 15 to 20 km distant. They give a fleeting idea of what the area must have looked like in the old days. Today the whole area is a giant refugee colony. Here are the old resettlements of Ukai. There the Karjan dam resettlements. And

all this area is reserved for the new colonies of the Narmada displaced. All the different 'project affected persons' have received different amounts of 'compensation'. This has resulted in some jealousy. The Karjan people are envious of the Ukai lot, while the Ukai people are jealous of the Sardar Sarovar refugees.

Ummarda village is a twenty year old settlement of refugees from Ukai. An Ashram school and a post-basic school are being run in this village by the Ukai Navanirman Samiti. Some time back, a number of 'Ambar Charkhas' were running in the village as part of rehabilitation and employment generation activity; right now this activity is almost dead. At least one person from each house has to go to Surat or Ankaleshwar in search of employment as a daily wage earner. People feel cheated and there is widespread dissatisfaction at the amount of compensation. They also strongly regret the loss of their culture and the sense of community that they had in the jungles.

There are some six or seven settlements of the Narmada refugees around Ummarda. Some are as old as three years while some had people who had just arrived a fortnight back. More are coming.

Nani Bedwan is an old village. This was settled during the time of the raja. There are some non-advansi trader families settled here from as far away as Rajasthan, M.P. and Maharashtra. Two years ago during communal tension in this area, advansis from outside the village came and burnt some shops and beat up some people. Twenty Muslim families fled the village during that time.

Just outside Nani Bedwan is one 'new' settlement of Narmada displaced. There are three tin sheds and a hand-pump which was not working. Some 15 to 20 families have come here very recently. There isn't a green tree nearby. There are some empty cotton fields. During daytime even in the month of February, it is terribly warm inside the sheds. Everybody is sweating. Some women bring a few pitchers of water. They point to a village a kilometer away when asked about the source of the water. Outside the tin sheds are some old bamboo, some wood and roofing material still lying around. Children are playing in the midst of all this. There is very little space left after two cots are put in the shed.

"Who likes to give up their father's land and come and resettle so far away from home? First, we were fighting for land and jungles. Medha Patkar Bai is from Maharashtra. That is why the Maharashtra people say "*Koi nahi hatega, bandh nahi banega*" But we are Gujaratis. That is why we are with Ambrish Bhai and Tripti Behn. They are Gujaratis and very decent people. After all we have to go with someone amongst the

sahebs. Today, every one of us has got five acres of land each. Although children of 18 years of age have still not got their five acres. An enquiry is being conducted to find out the ages of the children. Nobody has got the money for making the house. Those who came earlier, they received money for constructing houses. Each family had got fifteen hundred rupees. But we haven't got any. Our neighbours are thieves. Just last night they had come to steal our wood. It was lucky that we got up and made a noise and they ran away. We used to live in the jungles. Our village was Surpana near the river. There we had water and wood and food and medicines all from the jungles.

"Who likes to give up their father's land and come and resettle so far away from home? We used to live in the jungles. There we had water and wood and food and medicines, all from the jungles. Here, you see for yourself. There is not a tree in sight. Where will we get the firewood for cooking our food?"

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"There we were working as farmers. When there was no work in the fields, we would work as labourers breaking stones. Here there is no work. There all of us used to work and we would earn enough to last out till the rains. We have come here out of helplessness. It is better to come now while we are

still getting land rather be forced later and not get anything. Over there we used to farm seven acres of revenue land and five acres of forest land. All those who had more land, they have lost. If we work we will eat. There also we used to eat on our labour. Here too if God is merciful, he would give us the strength to labour. The land of our forefathers, irrigation facilities, all this is not written for us poor. The irrigation from Narmada is for those rich farmers who live downriver. It is not for us. What we have got is better than getting our houses drowned in water and losing whatever little we have."

The Gujarat Government keeps telling us that the Sardar Sarovar resettlement is the best that there is. And then doesn't somebody have to pay the price of development? When Ukai dam was built, this area of south Gujarat became sugarcane country. Did we not all prosper because we were able to grow such things like sugarcane and groundnuts? So what if the advansis of Uchhal and Nizhar had to lose their lands and are now reduced to a helpless state looking for employment as sugarcane cutters? If one person dies and two others can live comfortable lives then is it not better for the weak to die? Even the World Bank will tell you that the cost-benefit analysis shows that the ratio is better than 1.5. And after all these people are only advansis. We have made a tin shed, haven't we? Given each of them five five acres of land. Even put up a hand-pump. So what if it doesn't work. These people from the jungles, what more can they expect?

When will we ever wake up from our comfortable sleep?

Sanghomtira Gadekar

Profiting From Cancer

Vested Interests and the Cancer Epidemic

For years, the medical establishment in Europe and North America, in concert with industrial interests and academic representatives, has misled and confused the public by repeated claims that it is "winning the war against cancer." But despite the vast sums of money poured into cancer research, the incidence of cancers (standardized for age) has escalated to epidemic proportions, while the ability to treat and cure most cancers has hardly improved. Moreover, there has been a concerted effort to downplay the environmental and occupational causes of cancer; by highlighting almost exclusively the role of smoking and diet, an attempt has been made to shift the blame from industrial polluters to individual cancer victims who "have only themselves to blame".

In 1990, over one million US Americans were diagnosed as having cancer, and a half a million died of the disease. Cancer now strikes one in three people and kills one in four in the US, UK and most other western industrialised countries. This compares with an incidence of one in four in the 1950s, when the mortality rate was one in five.

Since the 1950s, age-standardised cancer incidence rates in the US have increased by 43.5 per cent overall, the rates for some common cancers rocketing. Between 1950 and 1988, lung cancer increased by 263 per cent, prostate cancer by 100 per cent, and female breast and male colon cancers by about 60 per cent. Rates for some less common cancers have also risen sharply: malignant melanoma (skin cancer), multiple myeloma (bone marrow cancer), and non-Hodgkin's lymphoma (cancer of the lymph glands), have increased by well over 100 per cent, while cancer of the testes and kidneys in males have doubled. Similar increases have occurred in industrialised countries besides the U.S. The only major declines have been for stomach and cervical cancers.

From 1975-1984, overall age-standardised mortality rates increased by 5.5 per cent — from 162 per 100,000 to 171 per

1000,000. Such national averages, however, obscure significantly higher cancer mortality rates within certain groups: the death rate among those over 75 years, for example, increased by 9 per cent from 1212 per 100,000 to 1351 per 100,000.

Some 75 per cent of all cancer develop in those over the age of 55. But there are notable exceptions, particularly some leukaemias, brain cancers and cancers of the testes, which strike mainly the young and have been increasing at alarming rates. For instance, the increase in testicular cancer among men aged between 25 and 34 has increased 300 per cent since the Second World War. Cancer rates are particularly high among the low income groups: blacks (with an incidence approximately 10 per cent higher than whites): those living near industrial plants, mines, chemical works and nuclear installations; and workers exposed to chemical and radioactive carcinogens. The rates for certain cancers are ten times higher among some industrial workers than within the general population. In addition, rates in children of workers who handle chemical carcinogens have increased sharply: the risks of childhood leukaemia are two to five times higher if there is parental exposure to spray paints, dyes or pigments during pregnancy.

Smoking as Scapegoat

Yet, contrary to their own data, both the National Cancer Institute (NCI) and the American Cancer Society (ACS) have insisted - until very recently - that the incidence and mortality rates of all cancers other than those related to tobacco, are not increasing: "We are not certainly experiencing an overall epidemic of cancer, except for that attributable to cigarette smoking." Similar unfounded assertions have been made by British epidemiologists such as Richard Doll who earlier this year, contrary to documented evidence, alleged that the increase in mortality from cancer "can be accounted for in all industrialised countries by the spread of cigarette smoking." Yet, as a recent study points out:

'In the USA and UK, mortality rate for lung cancer... have actually begun to decline in men, due in large part to reductions in smoking. Moreover, despite these reductions in lung cancer, incidence and mortality for many other types of cancer increased from 1969 to 1986 in 16 industrialised countries, especially in persons over age 66. The causes of these recent increases in cancer cannot simply be explained by smoking, but appear to reflect other exposures to*

changing factors in the environment.

Static Cure Rates

Highly misleading claims have also been made by the cancer establishment with regard to improving 'cure' rates for cancers (conventionally defined in terms of the number of people who survive for five years after diagnosis). In particular, the efficacy of the latest anti-cancer treatments - from cytotoxic chemotherapy to interferons and biotechnology products, such as tumour necrosis factor, monoclonal- antibodies and interleukins - have been grossly overstated.

According to NCI's own statistics, overall five-year survival rates from cancers in all ages and races improved marginally from 49.1 per cent to 51.1 per cent from 1974 to 1987 - the rates for blacks during this period actually dropped from 38.6 to 38.4 per cent. Even this minuscule improvement in overall "cure" may be little more than a statistical artifact: earlier diagnosis, for example, may extend the period between diagnosis and death, leading to the conclusion that the patient has survived longer, when the cancer may have proved fatal regardless of when it was diagnosed. The rates ignore the many patients who are judged "cured", but die from the recurrence of the same cancer after they have passed the five year period. This is particularly true for women with breast cancer.

Not surprisingly, the claims made by organisations such as the NCI and the ACS for advances in the ability to treat and cure cancer are meeting increasing scepticism. Five years ago, the US General Accounting Office stated:

"For the majority of the cancers we examined, the actual improvements (in survival) have been overestimated by the pub-

lished rates... NCI does not systematically alert readers of its annual statistics reviews to potential sources of bias that affect changes in survival rates. It is difficult to find that there has been much progress... (For breast cancer), there was a slight improvement... (which) is considerably less than reported."

More recently, in 1990, a leading biometrician concluded after a comprehensive review of the literature and a questionnaire survey of over 250 cancer specialists (oncologists) and research units worldwide that the benefits of chemotherapy for treating most epithelial cancers have, with the possible exception of the rare "small-cell" lung cancer, been greatly exag-

"Many oncologists take it for granted that response to therapy prolongs survival, an opinion which is based on a fallacy and which is not supported by clinical studies".

gerated.

Causing Breast Cancer

To make matters worse, many of the "cures" and putative "prevention" programmes promoted by the NCI and American Cancer Society may actually be causing cancer. Over the last two decades, for example, more than \$1 billion has been spent on "combating" breast cancer. According to a 1991 report by the General Office of Accounting, however, "there has been no progress in preventing the disease."

NCI programmes insist that the major cause of breast cancer is a high fat diet, ignoring the considerable evidence of the role of avoidable carcinogenic dietary contaminants. These include pesticides, such as DDT chlor-

done and dieldrin which concentrate in animal fats, and exogenous oestrogens in animal fat, due to the unregulated use of growth-promoting hormones as additives in animal feed.

Apart from adhering to such myopic science, the NCI and ACS have failed to investigate the carcinogenic hazards of mammography, particularly the relation between recently increasing breast cancer rates and 'high-dose X-ray mammograms administered to some 300,000 women during the 1970s as part of the Breast Cancer Detection and Demonstration Programme. Based on a wide range of previously published epidemiological data, a group of international radiation specialists estimated in 1972 that breast cancer risks would be increased by approximately one per cent for every rad of exposure. Thus, a premenopausal woman having one mammogram a year for 10 years, with a conservative estimated dose of two rads per exposure, would have a 20 per cent excess risk of contracting breast cancer. A confidential memo by the senior NCI doctor in charge of screening programme may explain why women were not alerted to this risk, in spite of warnings by the US National Academy of Sciences and by the NCI's own key scientific staff. The memo, which may also account for the cancer establishment's enthusiasm for the BCDDP programme stated;

"Both the ACS and NCI will gain a great deal of favourable publicity because they are bringing research findings to the public and applying them. This will assist in obtaining more research funds for basic research and clinical research."

The NCI has now embarked on a "prevention" trial which can only be described as a prospective experiment in carcinogenesis. Some 16,000 healthy women - deemed to be at increased risk of breast cancer for

familial and other reasons, including just being aged over 60 - are to be given tamoxifen, a drug which is structurally related to the synthetic growth-promoting hormone DES. Manufactured by the giant British pharmaceutical company Imperial Chemical Industries (ICI), tamoxifen not only binds very tightly to DNA, —a general characteristic of carcinogens— making it "a poor choice for the chronic preventive treatment of breast cancer" - but has also been described as "a rip-roaring liver carcinogen." This experimental evidence of potent carcinogenicity is confirmed by two case reports of liver cancer among 931 women receiving 40 milligram doses of tamoxifen for treatment of breast cancer.

Conflicts of Interest

Cancer care is big business; annual cancer drug sales in the US total approximately \$1 billion. Underlying the NCI's fixation with diagnosis, treatment and research into new drugs and other "cures" is an institutionalised alliance between interlocking professional and financial interests; the highly profitable pharmaceutical industry is at its hub.

Core members of this alliance - the "cancer establishment" - include:

- The National Cancer Institute and the powerful "philanthropic" American Cancer Society.
- The major US "cancer centers", notably New York's Memorial Sloan-Kettering cancer hospital, whose annual budget exceeds \$350 million, and Boston's Dana-Parber Cancer Institute;
- University departments and staff under contract to the NCI and the ACS or receiving grants from them;

. Major pharmaceutical connections between this cancer establishment and chemical, pharmaceutical and biotechnology companies have spawned "the drug-development industrial complex". Furthermore, a "revolving door" operates between the NCI, the major cancer centers and the drug companies. For example, Stephen Carter, head of drug research and development at Bristol-Myers Squibb, is a former director of NCI's Division of Cancer Treatment

A still more obvious conflict of interest relates to the three-member executive Cancer Panel which controls NCI priorities and policies. The panel is appointed by the US President under the terms of the 1971 National Cancer Act. Of its past chairs, the longest serving was Benno Schmidt, an investment banker, senior drug company executive, and member of the Board of Overseers of the Memorial Sloan-Kettering. He was followed by the late Armand Hammer, chair of Occidental Petroleum, the company responsible for Love Canal and numerous other pollution disasters, and a major manufacturer of carcinogenic chemicals.

Such conflicts of interest explains to a large extent why treatment, not prevention, has been and still is the cancer establishment's overwhelming priority. Of a \$2 billion budget in 1992, NCI claims to have allocated about \$646 million or 30 per cent to "cancer prevention". Included in the "cancer prevention" budget was allocation of some \$335 million • 17 per cent of the total budget • for "primary cancer prevention". But only minimal funding - \$60 million at most - has apparently been awarded for research and interventions into avoidable carcinogens in air, water, food, home and the workplace (with the ex-

ception of wide-ranging smoking prevention programmes); only one per cent of the overall \$2 billion budget is earmarked for research into occupational cancer. No significant funding seems to have been given for efforts to reduce such avoidable exposures.

Cancer, Life style and the Environment

NCI reluctance to address the issue of environmental carcinogens typifies its "blame the victim" approach to the causes of cancer. In this simplistic and sometimes self-interested view, personal habits and lifestyle, not industrial interests, are held responsible for cancer: prevention concentrates on anti smoking campaigns, for example, rather than curbing more general pollution in the workplace and the environment.

The NCI's estimates of the causes of cancer are largely based on an obsolete analysis of trends in cancer mortality from 1933- 1977. Even when it was first published in 1981, the analysis was criticised severely by leading independent US authorities for its misleading statements on the causes of some, if not most, cancers and for its preoccupation with blaming the victims for faulty lifestyles, while trivialising or ignoring the role of avoidable exposure to industrial carcinogens. The report concluded, for example, that "there is no evidence of any generalised increase in cancer mortality other than that due to tobacco." This conclusion was reached by excluding from the study consideration of blacks (because of the alleged unreliability of the statistics) and people over the age of 66 • the very groups in which more than half of all cancer deaths have been reported - and by incorrectly ascribing lung cancer almost exclusively to smoking. The study was also devoid of any cited quantitative scientific

data, apart from that for smoking, for which the confounding variable of occupational exposures was completely ignored.

According to Doll and Peto of the Cancer Establishment, diet causes 35-70 per cent of cancers and smoking 30 per cent. Other causes, such as alcohol and sunlight, brought the total up to 96 per cent, leaving a balance of 4 per cent to occupational causes. This tenuous hypothesis flies in the face of evidence:

- * Over the last decade, a plethora of new studies have identified numerous products and processes as carcinogenic, including cancers in a wide range of organs, notably the brain, bladder, kidneys and bone marrow.
- * Based on exposure data, the US National Institute of Occupational Safety and Health (NIOSH) has estimated that approximately 11 million workers are exposed to occupational carcinogens.
- In late 1981, Peto backtracked and admitted that, "Occupational factors are likely to account for...a large percentage eg. 20-40 per cent of all US cancer. Even low estimates represent large enough absolute numbers of deaths to justify both intensive research and political action... A mere 2.5 per cent of all US cancer deaths would represent some 10,000 deaths per year."
- Of 37,000 cancer deaths each year in New York state, an estimated 10 per cent are due to occupational exposures. The same percentage applied to the US as a whole gives an annual mortality rate of 50,000.

The Brotherhood

The following table was published in the AERB Newsletter; the official organ of the Atomic Energy Regulatory Board.

Cancer Risk Factors in Dally Life	
Diet	33%
Tobacco	31%
Viral Infection	10%
Sexual	7%
Alcohol	4%
Industrial Occupation	4%
Hereditary	2%
Environmental Pollution	2%
Environmental & Medical Radiation	1%
Additives	1%
Unknown	5%

Based on E.H.Rosenbaum's "Can you prevent Cancer".

"In advanced countries the dose due to medical procedures are generally high unlike developing countries. Even in these countries background and medical radiation together possibly causes just one cancer out of every 100 cancers."

The above is a fine example of the "brotherhood"—the network of interest groups. Thus, we have the cancer establishment, basically saying that cancer is your own fault due to wrong diet, smoking, alcohol, sex, heredity, what have you, and the nuclear regulatory establishment— whose stated purpose is to protect the public from "unnecessary" exposure— then using these "findings of experts" in trying to imply that pollution general and certainly radiation are a cause for worry.

By the year 2030, it is estimated that asbestos - the single most important known occupational carcinogen - will have caused some 300,000 cancer and other deaths, including 60,000 non smoking related mesotheliomas (cancer of the chest of abdominal linings). Such assertions negate the continuing assertions by Doll, on whom the NCI still unaccountably relies, that asbestos is responsible for only a "few cases of mesothelioma"

- Over 20 US and international studies have identified parental exposure to occupational carcinogens as a major cause of which has increased by 21 per cent since 1950.

Reforming the NCI

The complex web of vested interests described above limits the feasibility of implementing the long overdue reforms of the NCI. However, pressure for reform is growing. A statement criticizing federal cancer policies, released in February 1992, was signed by 68 prominent experts in the fields of industrial medicine, carcinogenesis, and public health. Similar criticisms need to be levelled at the cancer establishments of other countries.

*Prof. Samuel J Epstein
The Ecologist Sept I Oct 1992*

This is an edited version of an address given by Professor Epstein at the May 1992 meeting of the National Cancer Advisory Board. A complete referenced version is available with The Ecologist. We have included this in Anumukti since radiation is one of the most potent carcinogens, and also because the cancer establishment in India is no better. Famous oncologists have lent themselves to spreading disinformation regarding effects of radiation and the tuberculosis detection programme could be leading us to a position where like mammography we would be creating a cancer epidemic in the future.

The Turkish Turmoil

E'ven as early as 1987, the health consequences of the Chernobyl disaster were apparent in Western Turkey, according to the German Magazine *Psychologic Heute*. This was the area which was most affected by the radioactive fallout from the accident. There were large number of babies born during that time with deformities, especially to mothers who were in their second month of pregnancy when the accident occurred. The most dramatic was the case of the village of Diizce, on the western coast of the Black Sea, where, in November 1986, ten babies were born with their brains outside of their skulls—an extremely uncommon condition. Recent reports indicate that the number of abnormal births has quadrupled in the city of Trabzon, since 1986.

A press report dated 13 March 1992 from the semi-official Turkish press agency "Anatolia" states that the Turkish Government is planning to bury 14,000 tons of radioactively contaminated tea. The report adds that 44,000 tons of tea have already been buried by the authorities.

However, at the time of the accident, the Turkish government was engaged in a programme of massive disinformation. A month after the accident the minister for industry, referring to people who pointed out the dangers of radioactive contamination, called them "godless persons". "A little radioactivity is good for the body," he said. The then Prime Minister (and the present President) Turgut Ozal, claimed that radioactivity was good for male virility. And both the politicians got themselves photographed drinking the supposedly contaminated tea in a propaganda bid to show how 'harmless' it actually was.

The government of Turkey at the time, tried all the tricks it knew to deceive the people. The state owned tea company, the distributor of the contaminated tea, printed 1985 as the year of production on packages containing tea that was harvested in 1986. Selman Kinaci, the head of the Institute for Nuclear Science, now admits that they found radioactivity in the range of 50,000 to 60,000 Bq/kg which is more than a hundred times higher than the 'permissible' limits. However, at the time the scientists were not permitted to publicise radioactivity measurements and were threatened with disciplinary measures.

Unable to sell contaminated hazelnuts abroad, the government carried out massive distribution of the nuts in schools and to army recruits during 1990-1991. The government also exported 4-5 tons of hazelnuts to Russia.

Now, the consequences of Chernobyl on Turkey are becoming obvious. The leukaemia rate is twelve times higher than before. Gunduz Gedikoglu from the Faculty of Medicine at the University of Istanbul and the head of a foundation for children suffering from leukaemia, says that, "We have looked at all potential reasons for the unnatural increase in leukaemia rates, and the only reason is Chernobyl."

The current government is using the then government's response to Chernobyl as a stick to beat the "Motherland Party", which was then in government. As more and more facts about the whole scandal become known, hundreds of charges are being levied against people responsible. Headlines in Turkish newspapers read "Chernobyl criminals to court!"

Anatolia news agency also reported recently that Turkey would soon have its first nuclear power plant. Yalcin Sanalan, the president of the Turkish Atomic Energy Agency said that "It is important to eliminate the psychological fears in Turkey caused by Chernobyl."

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While the increase in number of deformities and leukaemia (12 times greater than before) are obvious and are admitted by the present government of Turkey, which uses these tragedies as a stick to beat its political opponents who were the government at the time of Chernobyl accident, it too wants to take Turkey down the nuclear path. Yalcin Sanalan, the president of the Turkish Atomic Energy Agency said that "It is important to eliminate the psychological fears in Turkey caused by Chernobyl."

Public Awareness at Kalpakkam

Bhopal, Chernobyl, Three Mile Island are names which recall scenes, of horror and panic caused by large scale industrial disasters of recent past. It has been claimed, by nucleocrats among others, that the reason for the large scale devastation and loss of life involved in some of these accidents is due to the fact that people were not prepared in advance for the accident and its consequences. Of course, after any such accident, the first declaration from the authorities that one hears is that such a disaster is inconceivable in 'our' system. That ritual done, the next pronouncement one hears is that 'lessons' are being learnt from the catastrophe and the misfortune is some kind of a blessing in disguise, since it would mean that there would be better preparedness for future accidents. The accidents we have mentioned took place quite a long time back, so that one would expect that at least now, after a period of so many years, we are in fact well prepared to deal with any kind of nuclear calamity. In fact, after the Chernobyl disaster, an "emergency preparedness plan" was prepared and a number of drill and exercises involving the nuclear plant authorities and the civil authorities have already taken place in all operating nuclear plants in the country. The first time such exercises were undertaken in 1988, there was total confusion and panic. (See Anumukti vol.2 no.2/3) However, now that a number of such exercises have been conducted, the time is probably right to take stock, and see if the people in areas surrounding nuclear power plants are aware of their role in an emergency.

Makkal Ariviyal Iyakkan (People's Science Movement, Tamil Nadu) have recently undertaken this task, and conducted a survey of villages around the Madras Atomic Power Station (MAPS) at Kalpakkam in Tamilnadu. Their report is entitled "A Sample Survey On The Peoples' Preparedness in Case Of An Emergency And The Economic Effects .On The People Around Kalpakkam Nuclear Power Plant". Besides including the results and analysis of the survey carried out in 1992, the report contains additional information concerning the nuclear industry in the region and the perceived economic benefit to the population of the region.

AIMS

- To investigate the awareness of local people to the health and safety issues surrounding nuclear power and to gauge the potential reaction of people in case of nuclear accident

- To obtain the opinion of the local people as to their current and prior economic situation in order to gauge the actual effect of a capital intensive energy production industry on the people living in the area.

Methodology

The Kalpakkam plant is located midway between Madras and Pondichry, about 80 Km south of Madras, on the coast of the Bay of Bengal in Tamil Nadu. It has two reactors operating for the last 9 years. Amongst the villages which are spread all around the plant, are a number of fishing hamlets. The area experiences cyclonic storms almost every year during the winter month. The survey covered 36 villages and 21 PanchayaU within a 16 Km radius of the plant 369 people were surveyed either by individual or group interviews. Amongst the participants of the survey 12% were female and 88% were male. The caste distribution of the survey

participants was 1.6 percent forward castes, 68.8 percent backward castes and 39.4 percent scheduled castes and tribes. The educational qualifications of the participants varied from illiterate (32%) to above 10th standard (6.7%). The survey was conducted only amongst adults with 27% aged between 18 to 26 years, 33% between 25 to 36 years and the rest 40% being over 40 years of age. Special efforts were made to contact panchayat chiefs. The caste composition and the educational distribution of the survey participants reflects the overall distribution of caste and literacy in the area.

RESULTS

The survey tried to gauge people's knowledge on two aspects

- * Radiation and its Effects
- Knowledge regarding what action to take in case of an emergency

Report of an Interview with a Panchayat Chief

Below we reproduce verbatim an interview with a panchayat chief to illustrate the level of ignorance amongst these functionaries. M.A.I. stands for the interviewer, while P.C. denotes the panchayat chief. It is well to keep in mind the fact that these people form the main link between the authorities and the people and who are expected to be the main source of information and leadership in an accident situation.

M.A.I. : How will you get the message of a nuclear mishap?

P.C.: I will get the message from the Village Administrative Officer.

M.A.I.: Where does he stay?

P.C.: His permanent address is in Tirukalikundram, which is about 10 kms from here.

M.A.I.: Then how can he inform you in the evenings or the nights?

P.C.: (no answer)

M.A.I.: Where will the bus to evacuate people come?

P.C.: It will come near the temple tank.

M.A.I.: What will you tell the people?

P.C.: I will ask all of them to assemble near the indicated place.

M.A.I.: Is there any shelter there?

P.C.: No.

M.A.I.: How many buses will come there?

P.C.: Two or three buses.

M.A.I.: What is the population of this vil-
lage?

P.C.: There are about 400 houses with about 1,000 adults. Total population may be about 2,000.

M.A.I.: Where will they take you?

P.C.: To some place near Katankalthur, which is about 60 kms away.

M.A.I.: How long do you think it will take to evacuate everybody?

P.C.: Well, I really don't know, but we can calculate. A up and down trip takes about 2 hours. In one trip about 70

P.C.: We are the only ones. Who else?

M.A.I.: Docs that mean that you will not

leave this place for two days till the last person has boarded the bus and all the people have evacuated?

P.C.: Urn...!

M.A.I.: Where will people stay till they board the buses?

P.C.: Why? They have to wait here for the bus.

M.A.I.: Weren't you told that it is better to wait indoors till the bus arrives?

P.C.: I did hear something like that. But it is not practical. People will be panicky and would want to board the bus at the earliest. How is it possible to expect them to stay indoors ?

MAJ~ What about your food?

P.C.: Food! We have no choice. We will eat whatever is available. We hope the government will help us.

M.A.I.: What about the water?

P.C.: We normally drink the water from that well nearby.

M.A.I.: What about vegetables and milk?

P.C.: We can't afford to buy vegetables and milk from outside. We eat what we grow.

M.A.I.: But will you continue to use the water from the well and the locally grown vegetables and milk even after the accident?

P.C.: Yes, of course. Why not?

MAX: Were you not informed that all the products lying outside have a fair chance of getting contaminated and

On the basis of the replies received, the participants were characterised as belonging to three categories:

- Those who were unable to give any coherent answer at all to the question were classified as ignorant (53%).
- The second category was "knows something but not clear". Thus anybody who said that radiation can cause health hazards was put in this category (34.5%).
- Any body who said that radiation can cause health hazards when limits are exceeded, and this has a genetic effect, was classified as "possesses minimum clear knowledge" (12.5%) (*I would not agree with this definition - Editor*)

Only 12.5% of participants fell into the minimum clear knowledge category. Of these NONE were women. Most were forward caste and with higher qualification. Age and distance had little bearing on the knowledge base.

Similarly, people were categorized in the same three categories depending upon their knowledge of what to do in case of an accident. The percentage in the "Ignorant" category—(No coherent answer) was 68.8%. 26.6% of the respondents answered "We have to run. Government will help us. They will tell us what to do." Only 4.6% of the respondents who said that, "We should stay indoors till help comes. If at all we move in a vehicle we should move in the opposite direction to that of the wind," can be considered to possess minimum clear knowledge.

In this sample the knowledge base was found to be independent of qualifications or age. It is interesting to note, however, that none of the participants in either the highest qualification category or the for-

ward castes possessed minimum clear knowledge.

The surveyors note that the number of people who clearly know what to do in an emergency is dangerously low. The number of people who "know something but are not clear" are as vulnerable as the totally ignorant lot since the probability that in an emergency they would take the wrong step is high.

The number of people who clearly know what to do in an emergency is dangerously low.*

The organisers of the survey made "special attempts" to meet with Panchayat Chiefs. See Box for a verbatim report of a conversation with a Panchayat chief.

The report states that, of the four Panchayat Chiefs interviewed, "none of them knew that they have to stay indoors. A wet cloth on the nose will help, outside uncovered food and vegetable should not be used, only water kept inside should be used ... , where buses will come and how they will regulate people to buses, how much time or how many days it will take them to evacuate, what will be the facilities that will be provided, who are to be evacuated first"

Economic Aspects

Besides focussing on emergency preparedness, the survey also put question to the participants on their economic well-being due to the plant It is generally claimed by the governments that such mega-projects 'develop' the local area, and create new employment opportunities and 'elevate' the general condition of the people. About 700 crore rupees of public money were spent to set up the MAPS complex. Since there are

about 3,500 permanent employees and about an equal number who work as casual labourers on a temporary basis, this works out to about Rs 20 lakhs spent in the creation of just one permanent and one temporary job! In order to focus on the benefits received and economic penalties that might have been paid, by the local populace, the following queries were put to the respondents:

- 1. Whether there was any change in their income due to the plant
- 2. Whether they or their family members had got any jobs (government/ contract /other)
- 3. Whether they felt that the cost of living in the neighbourhood had increased due to the high income employees of the plant

It became apparent in the survey that the first two points are dependent on the distance between the home and the plant. Those living close to the plant got considerably more 'contract labour' work. However only 2.2% of the people surveyed very near the plant got permanent Group D (sweeper/helper) jobs in the atomic energy establishments. And from the data it seems that their age and qualification has not given those living near the plant any advantage in obtaining permanent jobs.

Only 15% of the respondents had obtained contract labour jobs. And these jobs have not affected their economic status in any way. Of the people who have got jobs, most were from the less educated and the scheduled castes. The survey concludes that "the scheduled castes who are normally farm 'bonded' labourers, prefer to come out and work as coolies for marginal or no economic benefits. This in a way gives them freedom from their age old feudal masters, but only to serve their new masters." The report

goes on to say that this appears to have 'loosened the traditional feudal grip on the harjjans.'

Not a single woman in the survey had a permanent job in the government or allied establishments.

During the course of the questioning other relevant information also came to light "It was found that many of the people whose lands were taken for the project were promised jobs but were not given them. They feel they have been deceived and show their 'certificates of preference' given by the Thasildars with anguish and despair."

The authors of the survey conclude that "the local economy has been imperiled by an increase in the cost of living and the accentuated economic differentiation." They feel that "Rs 700 crores of public money has brought in only economic deprivation along with high risk dangers to the local people. All the so-called 'economic benefits' have accrued only to those already better off or to the salaried classes coming from other parts of the country. The response among the 'beneficiaries' (those living within 5 km from the plant site) to a proposal for a new reactor in the area was vehemently opposed to the whole idea.

In the area near the plant and also in the area near the township for the workers of the plant, people overwhelmingly believed that the cost of living had risen since the construction

of the plant And a comparison with villages 30km away indicated that prices were indeed higher in this region.

Other Information

Besides the survey there is some additional information concerning water usage and salinity resulting from the Kalpakam plant's massive use and diversion of water. The township has a population of around 20,000. These 20,000 people consume 5.56 million litres of sweet potable water every day. Besides this consumption, the plant itself also uses 6.4 million litres of sweet water daily. This water is pumped from huge pumps installed in the bed of the Pallar river. The location is also the source of water for some suburbs of Madras city like Maraimalai Nagar, Tarmbaram, Pallavaram, etc. This huge extraction of water from a river which has very little surface flow most of the year and none during the summer months, has resulted in a depression of the ground water level by 30 to 50 feet The pane hayat chief of Vayalur village claimed that sea water has already penetrated into the subsoil strata and the resultant salinity has devastated about 100 hectares of land in the area.

It seems that "this technology is totally alien to the local population and hence people are not in a position to even comprehend it".

Makkal Ariviyal Iyakkan

"People have a right to know the dangerous activity that is going around them. They also have the right to accept or reject such an activity based on their capacity to comprehend the danger."

Radiation and Chromosomal Instability

British researchers Murina Khadim, DA.McDonald, D.T.Goodhead, S.A.Lorimore, S.J.Marsden and E.G.Write of the Medical Research Council's Radiobiology

Unit in Oxford have developed evidence that alpha-particle irradiation may cause a previously undetected form of radiation injury. If this finding is confirmed, there would have

to be a reassessment of the harm done by alpha radiations, which have been ignored till now for the lack of effective monitoring techniques.

As is well known, ionising radiation, whether gamma, beta or alpha and x-rays, can harm human beings quickly or slowly depending upon the intensity of exposure. Effects can range from prompt death to acute and delayed (days to months) radiation sickness, to long delayed (years to decades) latent cancers, and other mutagenic breakdowns (generations).

Current radiation safety standards are in large part based on statistics for external radiation. These standards assume that high-energy penetrating radiation (such as gamma or X-rays) is significantly more dangerous than alpha radiations "which can't penetrate a piece of paper".

What the British researchers' experiments suggest is that alpha particle radiation will damage a cell even when it misses the genetically significant DNA in the cell's nucleus. Heretofore, the expectation has been that radiation damage to genetically significant DNA would produce a clonal (identically repeated) aberration, whereas radiation damage to any other part of DNA was previously thought to be a phenomenon that was effectively repaired, removed, harmless, or that did not occur. The British research suggests that radiation damage to the non-genetic DNA may in several generations, produce a variety of abnormalities, not just the single, identically repeated transformation resulting from damage to the genetic DNA.

Each cell in the body consists of a nucleus in a body of fluid called cytoplasm. An alpha particle, traversing a cell's cytoplasm but bypassing the cell's nucleus and its contained DNA, may cause a physicochemical derangement of only the cytoplasm. This disorder of the intracellular metabolic environment may, secondarily, disturb the nuclear DNA and cause a

consequent "chromosomal instability".

Although about 80% of the cells targeted are likely to be killed outright, some will survive to replicate. These may show no sign of their altered internal state for many generations. When they do, however, their appearance shows varied and multiple alterations, rather than the single repetitive clonal pattern seen in surviving generations of cells subjected to low energy transfer gamma or X-ray irradiation.

This variety of chromosomal change in daughter cells after alpha irradiation makes the nature of the radiogenic effect of a single impingement difficult and doubtful, if not impossible, to identify or predict-not merely for a given cell or set of cells, but especially for a total organism such as a human being. Only the pattern of new and diverse changes not seen under previous low level irradiations confirms the phenomenon and its interpretation.

The Prevailing Theory of Carcinogenesis

Briefly described, cancer formation is understood to be a process of initiation of a normal cell to abnormal growth, known as transformation. Growth is manifested by cell reproduction. Only after one or more such "clonal" cell replications is completed, does the cancer process, or expression become fixed or established. Clinical appearance in the form of a tumour will appear some months or even years later, depending on many promotional, hereditary or immune, latency and inhibitory factors. Such transformations may be both genetic or epigenetic. In a genetic process, the "human cancers occur as a result of changes or damage produced in the chromosomes of DNA of cells. Every irradiated cell is in-

All we have been told of the hazards of alpha radiation has been minimised by the assurance that exposure is very slight. Now this study suggests that deleterious changes can be expected, belated and variable. It suggests that such changes will be inherited.

initiated. Only a very small proportion produced transformed colonies (tumours)." In an epigenetic process of cancer formation on the other hand, other changes and damage are presumed to result from "regulation of DNA activity" by physico-chemical influences outside the genetic DNA sequence and structure, hence the term epigenetic.

The "chromosomal instability" phenomenon due to alpha radiation may be such an epigenetic process. Its demonstrated durability and persistence after many cell replications gives one pause to reflect on species implications. The potential for both metabolic and genetic cellular alterations and aberrations are vast, diverse and immeasurable.

Cancer is the most readily identifiable human disorder caused, contributed to, or facilitated by low level ionising radiation, but cancer and deaths are not the only outcomes of chromosomal instability.

Implications

Initiation of cellular transformation leading to cancerous growth may occur due to low or very low ionising radiation without the invasion of the cell nucleus or a direct impact on nuclear DNA.

Chromosomal instability materialises visually only some generations after the non-lethal radiation impact on the surviving cells.

While only 15-20 per cent of the cells exposed to the study's "very low doses of alpha radiation" survive, nevertheless 60 per cent or more of the surviving cells will show changes resulting from the exposure.

Heretofore, everything we have been told of the hazards of alpha radiation has been minimised by the assurance that exposure is very slight. Now this study suggests that deleterious changes can be expected, belated and variable. It suggests that such changes will be in-

herited and epigenetic, likely to show up as physical changes in later generations. Further, the study suggests that even very small exposures at the subatomic level are cumulative.

This points towards the conclusion that any man-made isotope has an impact on the global ecology, sometimes for millennia. Americium-241 is a case in point: It is used in smoke detectors for homes and commercial buildings. Only 1 micro-Curie of americium-241 is used in each smoke detector, but there are some 12 million of these devices distributed each year in U.S.A. alone. With a half-life of more than 400 years, americium-241 will remain potentially destructive for a period almost as long as human history to date.

*Radiation Events Monitor
Center for Atomic Radiation
Studies
P.O.Box 1036 Cambridge MA
USA.*

The Whitewasher Extraordinary

R. Ramachandran, the science editor of *The Economic Times* is something of a rarity. He belongs to an almost extinct breed: the pronuclear activist. Now, there might be many who hold pronuclear views, but they are not active. Even amongst the employees of the Department of Atomic Energy, there are many who are not only not active, but also not pronuclear. They are just doing a job — a technician's job or a scientist's job or an administrator's job, with no clear conviction as regards the nuclear issue. Ramachandran is exceptional since although he is not on the nuclear payroll, he has through his articles done more than anybody else in trying to resurrect the proverb-

ial figleaf to cover nuclear mismanagement and excesses.

In my view, having somebody like Ramachandran in the pronuclear corner, is an advantage, since unlike the paid spokesman in the nuclear lobby, he is both knowledgeable and has the ability to express his views with clarity. Thus, his contributions help to raise the level of debate from the rock-bottom of name calling and appeals to patriotism that is the staple from the 'authorised' members of the nuclear establishment.

-CIRUS LEAKS—No cause for alarm" is his latest offering which was published in *The Economic Times* of 19th Decem-

ber, 1992. Normally, it would be best to reply to such articles by writing letters to the editor. Unfortunately, I first saw the article just yesterday, (24.2/93) when Ashok Kumar sent a cutting from Bombay. It is already too late to reply by writing a letter to the editor, and moreover I want to bring this topic up in *Anumukti* so that readers can become aware of the mixture of half-truths and deliberate omissions that forms the pronuclear argument. I am not reprinting the article in full over here, since for one it is too long and secondly I feel that we do give more than enough space for the pronuclear point of view. What I will do instead is to quote illustratively from the article as a

specimen of the Ramachandran style of disinformation. All those who are interested can of course look up *The Economic Times* of 19.12/92 as well as *Anumukti* Vol.6 No.1. for a reprint of the original article by Rupa Chinai in *The Sunday Observer* which first highlighted the problem. Ramachandran states,

"While the media does deserve the credit for highlighting the incident, unfortunately such events tend to be projected with alarmist hues. For the public at large, scientific terms and units of radioactivity and its exposure such as curie (Ci) or becquerel (Bq), rad or Gray (Gy), rem or Sievert (Sv) do not mean much unless the numbers are put in the proper perspective."

After this fine preamble, Ramachandran then promptly proceeds to take advantage of the public's ignorance of these units by piling upon his readers heaps of data in different units. Thus we have

"December 14, 1991 - Radioactive water found to be leaking into the excavated pit. The water sample was found to have an activity of 40 Bq/ml. (One becquerel corresponds to one radioactive disintegration per second—human body contains 4200 Bq of potassium-40, i.e. 15 million disintegrations per hour, 455 Bq of rubidium-87 and about 2900 Bq of carbon-14; Milk contains 45 Bq of potassium-40.)"

Along with this Ramachandran also gives two tables. One titled "Median Values of Cs-137 levels" and the other "Radiation Doses to public through food". The first gives values of cesium-137 activity in sea water, marine organisms and solar dried salt for various years from 1983 to 1992. The units in these values are mBq/l and the values range in the case of sea water from a low of 40 in 1991 to a high of 836.2 in 1984.

Let me borrow Ramachandran's own words and put these numbers in "the proper perspective". The impression one is apt to get from a reading of the article is, why are the antinukes in such a flutter over a mere 40 Bq/ml whereas the human body contains 4200 Bq of radioactive potassium, not counting the rubidium-87 and the carbon-14. What Ramachandran so conveniently fails to mention is that the human body in question is that of an adult male with a hypothetical weight of 70 kilograms. Thus the equivalent number in the same units (Bq/ml) for the radioactive potassium in the human body is 4200 divided by 70,000 which is equal to 0.06 Bq/gm. (Since the human body consists mainly of water and one millilitre has a mass of one gramme there will not be any significant error in replacing Bq/gm with Bq/ml.) Or in other words, an amount of sea water lying on the grounds of the Bhabha Atomic Research Centre equal in weight to an adult human being would have given off not just 15 million but 10,000 million disintegrations per hour.

However, even this is not the whole story. It is just the beginning. As the table headed median values of Cs-137 levels mentions, the radioactivity of sea water in the year 1991 was 40 mBq/l. Since the water was leaking from a pipe which was bringing in sea water into the complex, the radioactivity of the water in the excavated pit ought to have been 40 mBq/l. Instead it was 40 Bq/ml. The small m, is a factor of a thousand which instead of dividing is multiplying the coincidentally identical value. Thus, the amount of radioactivity in the water leaking from the pipe was a million times more than what it was in the sea from whence it came. The question is how come?

The cause of this extraordinarily high value of activity was due to leakage of nuclear waste

from another pipe which had contaminated the soil of the whole area to a dangerously high level and the water leaking from the sea water ingress pipe had picked up some of that activity. The soil in the area was contaminated to the extent of 1,000 to 60,000 Bq/gm. In other words the soil was a thousand times more contaminated than the leaking water which itself had a million times more radioactivity than the 'natural' radioactivity in the sea. Putting all the numbers in the same units allows the concerned readers to form their own perspective, rather than relying on the "proper perspective" of interested partisans.

I will give just one more example of Ramachandran's selective use of facts and advocacy style of journalism. Consider this

"To contain the radionuclides a vermiculite layer of 30 cm followed by fresh soil, has been used to fill the pit. This is expected to retard the migration of the radionuclides. The radiation field at this spot after filling was found to be 0.4 microsievert I hour. A person working at that location for 40 hours a week for 50 weeks a year would be exposed to a dose of 0.8 mSv. The annual dose limit for a radiation worker is 20 mSv."

However, this needs to be read in conjunction with the following

"December 20 1991—Entire area surveyed. High radiation field on pit top (with dose rate of about 300 millirem/hr) detected requiring remedial action."

And also this

"Based on the radioactivity level ratios of the short-living Cs-134 and long-lived Cs-137, investigations have concluded that the leakage had been taking place for some years at least. Since the

leakage woe at a totally unexpected spot which is not under routine surveillance it remained undetected, according to Atomic Energy Regulatory Board."

Now let us do the same exercise as Ramachandran does and estimate the annual dose to a worker who might have worked at the spot for 40 hours a week for 50 weeks a year for the unknown number of years before the leak was detected, because it "happened at a totally unexpected spot".

1 rem is a hundredth of a Sievert, and thus 300 millirem/hr is equal to 3 millisievert an hour or 3000 microsievert an hour. Thus, the yearly dose comes to 6000 millisievert (mSv) which is merely 300 times the annual dose limit for a radiation worker.

Of course one needs to remember that this is an academic exercise. Nobody was working at the spot which happened to be the lawn behind the CIRUS reactor. However, people did loiter there and the dose that they received at the place was in addition to the presumably 'monitored' dose they received during their regular work. The moral of the story seems to be: **Do not loiter while at work in the Bhabha Atomic Research Centre. Unexpected places can kill you due to unexpectedly high radiation levels.**

These numbers indicate a very different picture than the one Ramachandran has tried to present. They indeed constitute a cause for alarm. However, Ramachandran's main thrust is different. He is basically trying to tell his readers that although there has been an accident within the BARC complex its implications for the people outside are minimal and the general public can rest content that

these "anomalous radioactivity releases have had no adverse impact".

In his own words,

The most important concern is whether the leakages have led to any appreciable increase in the radioactivity levels in tea-water and marine organisms. (See Table 1) The BARC conducts tests on tea water, solar salts and marine organisms of over a hundred samples every year collected from 18 locations. These tests have demonstrated that during 1992 there has been no detectable increase in the concentration of the radionuclides."

For all anybody knows, this contention may well be true, but how is one to know. It might have so happened that for many years past leakage in the radioactive waste carrying pipe has deposited this waste in the vicinity of the reactor and has mercifully not carried them out to sea. Unfortunately, the source of all the reassuring figures and tables that Ramachandran presents is BARC itself—an interested and discredited party, as even Ramachandran would agree.

However, Ramachandran has another argument to assuage public fears in case these BARC generated numbers fail to impress, and this ace up the sleeve is that famously (in their own words) "independent" body, the Atomic Energy Regulatory Board (AERB).

"Even such a low-index event cannot be hidden by the BARC authorities even if they wanted to, because there is a regulatory authority to which they are answerable—the Atomic Energy Regulatory Board. One would have been accused of being extremely naive to swallow this some years ago when the auton-

omy of the Board was always in doubt. But now the Board does appear to have come into its own.

As a proof of the Board's independence, we have in 14 points bold highlight the following

In July, AERB wrote to the BARC director expressing his serious concern over sub-soil contamination.

Suffice it is to note that in this very instance of the leaking pipe in BARC, the reactor authorities showed their contempt for AERB directives and restarted the reactor on February 5th 1992, at a time when the pipeline had not been repaired, while the Reactor Safety Committee had asked them not to start the reactor till all the leakages in the pipeline had been isolated and repaired. This disdain of AERB will continue to be a regular feature of DAE facilities till the body becomes truly independent and takes its regulatory role seriously and not as a part of "allaying public fears".

The nuclear establishment in this country is a huge operation and has a large number of paid propagandists, public relation officers, media specialists and the like. Over the years, they all have managed through persistent deception and due to their total disdain of the concept of public accountability, to have lost their credibility. Nobody gives two hoots for their 'cooked' data. Thus, their need for a supposedly 'independent' expert like Ramachandran is obvious. It is a pity however, that Ramachandran has let his obsession with the nuclear dream to get the better of his scepticism which ought to be the bedrock of any scientist.

Surendra Gadekar

February/M
arch 1993

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Two hundred and fifty rupees may not exactly feel like peanuts. But in these inflationary times with the government dedicated to squandering our money, it may not be long before even peanuts may not be available at this amount. But Anumukti would be if you make a lifetime subscription, (just Rs 250/-) right now. (This offer is valid only within India.) This is your last chance of getting Anumukti at this special rate. Starting with the next issue, the lifetime subscription rate will be Rs 500/-

According to a television documentary broadcast late last year, it was common

Robotics Nuclear Style

practice in the first East German nuclear reactor at Rheinsberg (70 km northwest of Berlin) to send people into the conduit pipes of the primary coolant system to check for welding cracks and possible leaks. During the inspections, the water in the pipes was released and the interiors of the pipes were cleaned by a chemical substance to remove radioactive particles. The workers some of whom came from a Yugoslav firm, climbed into the pipes. A rope was attached to their feet so they could be pulled out. No figures have been released regarding the amount of radiation the workers were subjected to in this procedure. Robot cameras were not then available in the GDR. But since the emergency core cooling system was not sufficient, a failure of the primary cooling system would have proved fatal. Thus inspections were obviously very necessary and important. The Rheinsberg Reactor—a 70 MW reactor of Soviet design—began operation in 1966 and was shut down in June 1990. It is being prepared for decommissioning, which is expected to last till 2009 and cost an estimated 800 million German Marks.

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