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NUCLEAR TECHNOLOGY AND HEALTH

Nightmare of a Dream

ON DECEMBER 2, 1942 the first nuclear reactor went critical, releasing for the first time the enormous energies of atomic fission and ushering in the nuclear dream. But the reality was to be different; the dream rapidly turned into a nightmare. By the end of that decade not only had energy from the atom claimed 'war victims' but it had also shown its potential in killing, maiming and scarring for life anyone who worked with it. As early as August 19 a young worker at the Los Alamos 'atom bomb laboratory' working on fission studies died an agonising death after accidental exposure to radiation even as his numerous colleagues transporting fission material or experimenting with it were becoming permanently affected. By the fifties while several countries had built commercial reactors producing electricity, well-developed weapons programmes were also under way. And that was when the myth of the peaceful atom took shape and gained substance.

The nuclear debate, in addition to being a human rights issue directly impinges on all aspects of health care. A nuclear war, even a limited one, would be completely unmanageable by even the most efficient and most sophisticated health care system. (See p 112) Moreover no weapons system, even if meant as a deterrance, and however rudimentary/skelatal can be built up without some kind of testing of the devices. This has a direct consequence for the burden of ill-health among people not only of the affected region, but globally. And then there is the expenditure on armaments which is eating into the already meagre health and welfare budgets. While this is true of all countries, it has a more disastrous impact on poor nations. The 'peaceful atom' too is a health hazard. Three Mile Islands and Chernobyls can with the increasing proliferation of nuclear reactors, happen more frequently. With the secrecy which is an integral feature of the international nuclear industry, we may not even know when and if such disasters have taken place. Besides, evidence is accumulating on the long-term effects of low-level radiation, once thought to be 'harmless'. (See p 113).

'Atoms For Peace'

It is not an accident of history that the Atoms for Peace programme was proposed by Eisenhower in 1953. By then the military expenditure on nuclear installations had overshot anything that the country had spent even during times of war; the anti-bomb lobby while certainly not influential enough to change the course of development, at least had nuisance value; nuclear reactors whether for peaceful uses or for war weapons development were essentially the same; under US legislations weapons technology could not be shared with non-weapons countries—an important political lever for other kinds of gains in international diplomacy; it was only logical therefore to devise ways and means of continuing and expanding research and development efforts in nuclear sciences which while being ostensibly 'civilian' could easily be harnessed to war efforts when needed.

Thus the technical linkages between peaceful and military nuclear reactors—i e, the fact that it is during the process of controlled fission that the bomb material is produced or that the enrichment plants used to produce fuel for the 'peaceful' nuclear reactor can also, with sufficient modifications, be used to manufacture bomb material—have been politically reinforced. To argue that the two, the peaceful atom and the military atom are different is neither politically nor technically tenable.

It is in this context that the Indian nuclear programme got under way. It would be incredibly naive today to believe that the Indian bourgeoisie at the time of independence were not aware of the weapons potential of the peaceful nuclear programme. The fact that the programme has from the beginning been accorded high priority in terms of funding, that it has always been under the prime minister's direct control, the creation of the Atomic Energy Act with its unbelievable powers to suppress information, and the fact that the department's accounts have never been open to public or parliamentary scrutiny or audit by the Auditor General of India are obvious indications that the weapons angle has always been kept in perspective in developing the programme. Events in subsequent years especially in the last decade have given further evidence of this.

The nuclear debate is not new. While the dissent of the 50s was generally focussed on nuclear armament, the first ever protest against a nuclear power reactor was organised in 1957 in the US. But it is in the seventies that the nuclear debate came into its own. Throughout the 60s even as more and more 'peaceful' nuclear reactors were being built, data was also accumulating about radiation-related deaths among victims exposed to nuclear test fallouts, about the numerous things that could go wrong in a nuclear reactor, and about the potential long-term effects of low-level radiation.

Throughout the fifties the US continued to test nuclear weapons in a variety of geographical locations—66 of the 200, were in the Pacific ocean. While radiation damage from the fallout had been accumulating slowly over the years throughout the area, it was the Rongelap or the Bikini test which brought home to the world not only the horrors of the nuclear armaments programme even during peace time, but also the horrendous coverup used by the US and every other state which has had anything to do with the atom—the denials, the coverups and the secrecy. Children of Rongelap played in the 'snow' from the massive fallout from the test which entirely covered the ground for 78 hours before the US decided to inform the islanders of the deadly radiation and evacuated them. The first five years saw a sharp rise in miscarriages and stillbirths; but it was only after 9 years that the US medical experts acknowledged that the children were particularly prone to thyroid problems and the seriousness was highlighted when a 19-year-old boy who had been the youngest to play in the 'snow' died of leukaemia. Women from Rongelap continue to give birth to what they describe as "a bunch of grapes"—a consequence of radiation exposure because of which cystic grape like structures occur in the uterus or sometimes a single hydatiform mole is formed from a fertilised ovum which has lost its nucleus.

The peaceful atom too was beginning to show its belligerence—the increasing health problems of nuclear workers—the uranium miners, the transporters, reactor operators and the whole army of workers—was forcing several nations to pass legislations. But this also led to successful efforts to formulate so-called safety standards which only obliterated the real effects of radiation damage.

It is interesting here to point out that the international bodies which are supposed to set the limits of exposure and monitor it are themselves open to criticism of bias. Moreover, even as evidence accumulates about the extensive and long-term damage due to nuclear operations, the levels of exposure etc have been revised and concepts modified to accommodate them. For instance, it is now accepted that there is no safe dose of radiation; therefore the 'permissible dose' was evolved. And ironically enough it is not the health establishment which has traditionally been involved with monitoring these aspects; the discipline called health physics which evolved at around the time of the first nuclear reactor has been dominated by physicists and engineers and its fundamental concern has been to give the nuclear industry a clean chit. (See page 119 for discussions on the biases in concepts of 'risk' and safety'.)

Anti Nuke Debate

It is pertinent to ask why a debate which has been going on for over three decades needs to be given space and attention here. There have been several developments in the past few years about which we can neither remain unaware nor unconcerned. For one thing after four decades of the arms race the US and the USSR are on the verge of reaching a historic agreement on dismantling nuclear weapons in Europe. If the agreement on dismantling intermediate range missiles in Europe whatever its limited scope comes through it will be the first ever of its kind. Undoubtedly, national and global economic and political considerations have had a lot to do with the move, with the growing European peace movement, which is itself another manifestation of these considrations, providing a motive force. The growth of the peace movement cannot be measured only in terms of numbers but in terms of its political effectivity. One consequence of this has been the incorporation of many of the anti-nuke movements, demands into the programmes and manifestos of opposition parties in Europe. While the Green party has gained ground in West Germany in the last election, in Australia and Iceland too parties with a major focus on anti-nuke and peace issues have contested elections and won parliamentary representation. The communists in France are actively participating in anti-nuke demonstrations, for the country has continued to conduct nuclear tests in the Pacific despite worldwide protest. At Greenham Common, UK women have been camping outside the defence area in protest aganst the deployment of Cruise missiles.

In the Pacific too, several nations have come together to declare the zone a nuclear free one with many countries, including the USSR and excluding the US ratifying the declaration. Not the least of these new developments has been the spectacular impact of the International Physicians for the prevention of nuclear war (IPPNW) (See p 111)

But closer home a vocal nuclear lobby is pressurising the Indian state into giving the final signal to produce the bomb which is supposedly all but ready. Moreover the nuclear industry is planning the biggest expansion programmes, with a target of 10,000 MW of power from nuclear sources. Capitalist development in India poised to shift gears to a more rapid growth which will inevitably make demands for changes in the economy. The atoms-for-progress-and-peace theme is acquiring new meaning. Acquiring nuclear weapons capability not only becomes necessary as deterrance 'to keep peace' in the region, but also to reassert hegemonic aspirations. At the same time nuclear power with its long-term advantage of low labour inputs, centralised control etc is seen as the only means of providing for the power requirements of industrial growth.

Thus the nuclear debate has both a global and a national dimension and within this broad perspective are several issues. There is on the one hand the issue of how we view war, nuclear armament and disarmament at the global level as well as the national. Recent marxist analyses of war see it mainly as a condition of capitalist production. They argue that highly industrialised capitalist economies generate surplus value at such a rate that capital begins to accumulate rapidly and this inevitably leads to falling returns of investment thus leading to crisis. The creation of defence establishments which must be kept ready to strike at all times in terms of training, competence and technical superiority provides for vast capital expenditures in a justifiably non-productive fashion—ie without creating new value. Seen in this light the theory of deterrance, whether it is in terms of keeping huge conventional military establishments or building up nuclear armaments and deploying them becomes a conditions of capitalist production.

In the context of international capitalist development it is absurd to take one view of war and armament on the global level, i e, support disarmament efforts, while at the same time take a completely different view at the national level, i e, support the bomb lobby encouraging nuclear arms production.

Equally, it would be utterly naive and blind to try to delink the nuclear arms issue from that of nuclear power. Setting up a nuclear capability for producing 10,000 MW power is equivalent to establishing the base for producing a full complement of nuclear weaponry. But for the moment let us assume that it is possible for us to seperate the two. Would nuclear power be a feasible and safe proposition then?

It is important here to point out that India has been active on the peaceful nuclear front at every level of the nuclear cycle. Uranium is mined in the country; this ore as well as other fission materials can be processed and enriched, albeit to a limited extent according to official sources; we have several reactors which even if they have never been working efficiently to produce power for which they were ostensibly set up they have been producing fission products in large quantities and huge quantities of radioactive waste; India has had a sophisticated reprocessing facility for almost as long as it has had its first power reactor and it has had to store the long and short half life wastes in many dumps.

There is today enough information worldwide to show how workers and "non-workers in and around these various nuclear establishments are being permanently affected by radiation damage. Indian studies (see p 124) have shown just how incapable the department has been in monitoring the health of workers in the Rare Earths plant at Alwaye in Kerala one of the oldest such plants in the country. Since the 70s several stories of how workers are exposed to high radiation doses during cleanups have reapetedly surfaced from Tarapur and Rajasthan. The department has kept on record of people around any nuclear installations; but recent studies in UK have shown a definite possibility of childhood leukaemia clusters around power plants and no significant contraditions have as yet come forth despite close scrutiny of the studues. And nobody is aware of where the nuclear waste dumps are which is classified information under the Atomic energy Act Government control.

In fact the Act which vests extraordinary powers with the state is perhaps the most draconian of legislations in the country. It permits the nuclear industry to get away with criminal negligence of the most basic safety norms. And yet quite amazingly, it has, by and large escaped criticism—the Parliamentary opposition has never made an issue of demanding a review of the Act.

And then there are two other issues—one of the possibility of accident at a nuclear facility and the other of 'retiring' old plants. It is clear now that Three Mile Island and Chernobyl, the two publicly known nuclear accidents are not specific and rare instances—they can occur at any point in the nuclear cycle, no matter how fail-safe the process. The secrecy which is part of any nuclear establishment anywhere in the world makes it impossible to ensure the safety of populations around. Only in the last decade has the issue of what to do with old nuclear plants received attention. The dilemma is that firstly, the expenses involved in shutting down are enormous, secondly a nuclear plant unlike other establishments cannot simply be abandoned it is in the nature of a time bomb because it will be radioactively 'hot' for a long-time and has therefore to be safeguarded and thirdly in the bright dawn of the nuclear era nobody had thought to make provisions, costwise or otherwise about dismantling these monsters.

But notwithstanding all this there is yet another facet of the picture which demands attention. Atomic energy has not only produced electricty but a variety of nuclear products used in a range of applications, particularly in medicine. There can be no denying the fact that the use of radioisotopes have enormously benefitted biomedical and engineering sciences and there is no substitute for radiation therapy with all its drawbacks and problems. While it is true that the technology to produce them may be different, can it not be argued that this is in many senses a matter of scale? Can we seperate this from the rest of the issue and would it be possible to confine all future applications, research etc only to these areas. Can scientific developments no matter what their impetus and the predetermined boundaries of growth, be entirely contained?

The Indian anti-nuke movement has been of fairly recent origin—but it has already made considerable impact on an establishment, which for the first time has been forced to give serious consideration to sensitive questions. But the medical establishment, has in keeping with its class interest kept out of the picture.

However, if health is our everyday concern and if we believe that health care in more than medicare and is a political issue, we have to confront the nuclear issue. For, in doing so, we confront in quintessence, the contradictions and consequences of world capitalism.

Padma Prakash

Medical Response to Nuclear Threat

IN 1961, a group of young physicians from Boston founded an organisation called Physicians for Social Responsibility (PSR). Among them were Bernard Lown, Jack Geiger, Victor Sidel and Sidney Alexander. Beginning with an historic article in the *New England Journal of Medicine,* they calculated and publicised the medical consequences of a nuclear weapon detonated over a major city.

After a period of dormancy, PSR was revived in 1978 by another group of young Boston doctors, including Helen Caldicott, Eric Chivian and Ira Helfand. The organisation was concerned with both nuclear weapons and nuclear power, and developed a national constituency in the wake of the accident at the Three Mile Island nuclear reactor in Pennsylvania. In the following year, PSR decided to focus its attention on the nuclear arsenals. Dr. Chivan, a psychiatrist at the Massachusetts Institute of Technology and Harvard Medical School, agreed to design and organise the first major American conference on the medical consequences of nuclear war.

At the same time, Dr. Lown and several other American physicians, including Harvard Medical School professors Dr. James Muller and Dr. Herbert Abrams, began discussing the possibility of a Soviet-American medical dialogue on nuclear war. Dr. Muller had studied cardiology in the Soviet Union and later visited there on official delegations. He and Dr. Lown agreed there should be some kind of joint effort by Soviet and American physicians to address the nuclear arms race. Together with Dr. Abrams, chairman of the radiology department at Harvard, they formulated a strategy for approaching Soviet colleagues.

One key element of that strategy was the personal and professional relationship between Dr. Lown, a professor of cardiology at the Harvard School of Public Health, and Dr. Evgueni Chazov, director of the USSR Cardiological Institute. The two had first met in 1966.

Late in 1979 and early in 1980, Dr. Lown wrote to Dr. Chazov with a proposal to create a Soviet-American physicians' movement to prevent nuclear war. The proposal reasoned that doctors owe a professional duty to address the greatest threat to human life, and that an East-West medical organisation would be particularly effective in alerting the public and persuading governments..

In April 1980, Dr. Lown travelled to Moscow to ask Dr. Chazov to urge his Soviet colleagues to join such an effort. Dr. Chazov was encouraging, and in the spring of 1980, Dr. Lown, Dr. Abrams, Dr. Muller and Dr. Chivian incorporated IPPNW as a non-profit, educational organisation.

The efforts of the Boston physicians led to a meeting in December 1980 in Geneva between three American doctors and three to lay the international foundations of IPPNW.

Soon after, a small group of US physicians assumed the task of transforming the concept of IPPNW into an organisatioal reality. Their initial assignment was to organise the First World Congress of IPPNW. The Congress, held near Washington D.C. in March 1981, attracted 70 doctors from twelve countries.

In the eyes of the western press, the dramatic news from the First Congress was the presence of the Soviet delegation. When Soviet doctors joined their American, European, and Japanese colleagues in calling upon Presidents Reagan and Brezhnev to preclude the use of nuclear weapons "in any form or on any scale", the Congress achieved a major goal of the IPPNW founders—demonstrating to the world that American and Soviet physicians could co-operate on the gravest public health question of the time. This fact was under-scored by the widespread coverage given the Congress by Soviet press and television.

Soon after the First Congress, the American Medical Association, after reviewing material submitted by IPPNW and its US affiliate, Physicians for Social Responsibility, passed a resolution which recognised the professional obligation of doctors to educate their patients on the medical effects of nuclear war. The basic message of IPPNW's founders had entered the mainstream.

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We Apologise

For Irregularity and Delays in Bringing out RJH

The reasons have been mainly technical and financial. But we are generally out of the woods and would be much more confident if we are assured of your continued support! So please do renew your subscriptions.

We will be bringing out the next issue, the first of the new volume in the next 45 days, at the latest. The focus of the number is 'Medical Technology and Health' and we're sure it will raise a number of issues for debate. Do make sure you get your copies. After that we hope to be back on schedule with: Drugs and Pharmaceuticals; Health in People's Movements; Health and Agricultural Development.

Financially, the Socialist Health Review Trust is collecting a corpus fund so that RJH can be supported. This fund is being collected through individual and institutional donations and donors may avail of tax benefits under the ATG scheme. Apart from this RJH is seeking life subscriptions of Rs 500 from individuals and Rs 750 from institutions. This will form a corpus fund which will support the publication from the interest earned. We aim to collect a minimum of 100 life subscriptions by the end of the year and we have quite away to go as yet. We would really appreciate your support/help in reaching the target.

One of the major objectives of the journal was to bring to readers material, opinion, debate and analyses, not easily accessible to activists and which would enrich and enlarge the marxist understanding of health. We believe the RJH has made significant contribution in the area and will continue to do so. We collectively recognise the political necessity of such an endeavour. No matter what the odds, RJH will continue to be published. We appeal to you to help us in whatever way you can.

RJH Collective

Anatomy of Nuclear War

achin vanaik

The date August 6, 1945. The Place - Hiroshima, Japan.

"NO one could understand what had happened. Thousands began to flee the city. Most of them seemed to be hurt or mained. Eyebrows were *burned* off, skin was hanging from faces and hands. were vomiting. Almost all had their heads bowed, looking straight ahead, were silent and shared no expression whatsoever. In general, survivors that day assisted only their relatives or immediate neighbours, for they could not comprehend or tolerate a wider circle of misery.

Towards evening the streets became quieter; "Now not many people walked in the streets but a great number sat and lay on the pavement, vomited, waited for death and died." Even now there was no organised help masses were dead, masses were dying. "They all felt terribly thirsty and they drank from the river. At once they were nauseated and began vomiting and they notched the whole day." There were a few people who were capable of helping others. Survivors that evening noted that the asphalt on the streets was still too hot to walk on with comfort. Two men noticed "a pumpkin was roasted on the vine", which was eaten. Potatoes under the ground were found to be baked and were gathered for food. Many desperately ill survivors found their way to the sand pits on the river deltas. The tide was coming in. Many were too weak to move themselves but were helped by exhausted survivors. "He reached down and took a woman by the hands, but her skin slipped off in huge glovlike pieces." Others were moved up the sand pit but the following morning they had gone as the tide had came higher than expected.

During the first day, Father Kleinsorge was asked to help some soldiers. "When he had penetrated the bushes, he was there were about 70 men and they were all in exactly the same nightmarish state; their faces were wholly burned, their eye sockets were hollow, the fluid from their melted eyes and run down their cheeks. This was the result of having their faces upturned when the bomb exploded." (Based on the book *Hiroshima* by John Hersey).

Not long afterwards during the Korean War, the American Pentagon devised what it called the 'Hiroshima Death Function' (HDF) to calculate what would be the effect of using nuclear weapons in a selective manner. This HDF was an algorithm to calculate mortality as a function of distance from ground zero of an airburst nuclear explosion. The HDF is

$$D(r) = 0.93 \, Exp -\{0.693 \; [(r - 800)/850]^2\}$$

where D = Deaths and r = slant distance in yards from point of burst for r greater than 800.

Despite the evil of nuclear weapons and the widespread revulsion at what happened in Hiroshima and Nagasaki, the contingent use of nuclear weapons has never been far away from the minds of nuclear warmongers. Certainly, these warmongers have few doctors or medical practioners in their ranks. Most of them are defence personnel, politicians, strategists, academics and so on. But how many medical practioners are aware of what a nuclear war means? And how many are actively opposed to such a war breaking out and to the nuclear weapons powers or potential nuclear weapons powers army themselves with such weapons?

Today, with the "live" experience of Hiroshima and Nagasaki a great deal is known about the medical consequences of a nuclear attack. A nuclear bomb explosion involves blast effects, heat effects, and the effects of ironising radiation. The proportions of these effects can vary depending on the size and nature of the bomb. For example, in the neutron bomb (the 'capitalist' bomb which kills people but does not damage property) the blast and heat effects are greatly minimised while the radiation effect is greatly enhanced. But in the 'normal' nuclear explosion, some 50 per cent of the energy goes as shock waves or other blast effects, 35 per cent as heat and 15 per cent as radiation. The range of these effects will be different if the bomb bursts in the air blast and heat range will be greater) than if it bursts on the ground (radioactive deaths, fall out etc, will be greater) or whether it explodes underground or underwater.

A sufficiently high overpressure (blast effect) on the human body will lead to rupture and haemorrhages in the lungs, air embolism and rupture of the gut and ear drums. In addition blast effects on buildings etc, will indirectly create many more human casualities through flying projectiles and falling debris etc.

The fireball of a nuclear explosion (small one) will look brighter than the sun at noon to anyone within a 50-mile radius of the explosion. To anyone looking at the fireball there is great likelihood of retinal burns leading to permanent blindness. The intense heat of such a fireball will raise flash burns of the skin. A partial thickness burn leads to blistering which can became infected. A full thickness burn is where the skin is completely destroyed. In both cases loss of crucial body fluids through the surface of the burn can lead to death. In addition, the explosion will create fires on the ground leading to flame burns which will cause lung damage through inhalation of smoke from a variety of burning materials especially plastic.

After a nuclear explosion comes the radioactive fallout as radioactive isotopes condense on debris and dust to produce the radioactive dustcloud. In the first 24 hours some 60 per cent of radioactive products fall to the ground. This is the early fallout. The 40 per cent which remains can take much longer to fall and can be dispersed over a wide area depending on weather, winds etc. This is the delayed fallout. This radiation causes damage to rapidly dividing cells such as those of bone narrow and the lining of the gastrointestinal tract. When the whole body is exposed one can get radiation sickness which is often fatal. One unit of dose i.e. energy absorbed per unit mass is called a rad and a dose of 450 rads will kill 50 per cent of young, fit adults. A dose of 150 rads will kill 50 per cent of elderly, already ill and children.

In the first form of radiation sickness/the bone-marrow form requires only an exposure of 150 rads. The first symptoms are lethargy and nausea, then nothing for 10 days. Towards the end of the second week there is maximum depression of the white blood cells and platelets which reduces the blood's capacity to clot and stop bleeding or protect against infection. Spontaneous haemorrhages often develop. By the fourth week many of the victims will die.

If the radiation exposure is high enough then there will be gastrointestinal damage where the cells of the small intestine are damaged. This leads to massive diarrhoea with loss of body fluids, to greater risk of getting septicaemia from bacteria emerging through the damaged living. If exposure is higher still, then the central nervous system of the body is damaged leading to convulsions, coma and death in a few hours. If the victim survives, there will be gradual loss of mental and physical faculties which then results in death in a few days.

Where radiation sickness does not lead to death, it can destroy, or damage fetuses in pregnant women. Brain damage was found in many children whose mothers were less then 15 weeks pregnant in Japan when the bombs fell. Small skulls (microcephaly) occured in 44 per cent of surviving children and 16 per cent were severely mentally retarded. The fregnancy of stillbirths and post-natal infant deaths rose dramatically.

The longer term effects of radiation through delayed fall-out affect those not directly affected by the explosion. In these cases, radioactive isotopes are ingested through contaminated foodstuffs and fluids, by inhalation and occasionally through the skin. Radiation-induced cancers apart from leukaemia (which occurs more quickly) can emerge after a latent period of 20-25 years. Genetic abnormalities and defects can take a number of generations before emerging since gene nutations are recessive.

Even a single bomb of the kind used on Hiroshima and Nagasaki would completely overwhelm medical resources. Quite apart from the psychological damage or the direct/indirect effects of the explosion, there would be a great deterioration in public health standard with sanitation facilities wrecked and incapable of coping with sewage clearance, providing clean drinking water and so on. Thus diseases like dysentry, infectious hepatitis an salmonellosis would be promoted. There would be diseases of overcrowding, meningococcal meningitis, diptheria and tuberculosis, diseases associated with dirt and vermin such as typhus and in Indian conditions, even plague. Common infections like pneumonia and septicaemia would become killers.

All this would be the effect of a few explosions. The effect of a nuclear war is simply unimaginable. The indirect effects would be far greater then the direct effects and impossible to calculate. As far as the environmental damage e.g to the earth's ozone layer, leading to worldwide and devastating ecological damage e.g. freezing of the temperate regions, submergence of large land masses under water, destruction of a large part of the world's agriculture, excessive ultraviolet radiation as atmospheric protection is eliminated—these are all part of what is now called the "nuclear winter" scenario which could become a reality even if there was a "limited' or "small" nuclear war in a remote part of the world.

In sum for *purely* medical reasons *alone*, nuclear war must never be allowed to occur. No government should contemplate it and it should never be allowed to happen no matter what the circumstances.

Why Nuclear Arsenals?

Why then do countries go in for building nuclear arsenals? Why then the insane nuclear arms race between the superpowers? Why then the attraction that going nuclear has for bomb lobbies in countries like India and Pakistan, which have nuclear weapons capability but have not as yet crossed the nuclear rubicon of openly deploying a nuclear weapons system?

Nuclear war is mind-boggling but precisely because it throws into the dustbin older preconceived notions of war and its possible purposes, so many governments revert back to older forms of thinking in order to cope with the mind-boggling character of nuclear weapons. That is to say, these governments or these nuclear politicians or nuclear strategic experts try to treat nuclear weapons in much the same way as they try to treat and cope with conventional weapons—they try to make nuclear weapons into *viable instruments of a country's foreign policy.* Since the uncontrollable dimension of nuclear weapons means that the use of nuclear weapons for political purposes is not viable (what possible political purpose can be justified by the use of such weapons?) what has become viable is not the use but the threat of its use. This is want is called deterrence. Having nuclear weapons becomes a way of assuring nuclear peace. Despite the universal character of nuclear weapons—its universal effects and the universal horror at its use—this way of assuring nuclear peace is not the least universal in character or orientation but is strongly nationalist. Deterrence becomes a way in which a nation prevents nuclear war breaking out between itself and another nation having nuclear weapons by *intimidating* it. Thus the foundation of nuclear peace is nationalist intimidation and distrust.

The great importance given to deterrence is ultimately a reflection of the bankruptly of those who have power in our societies. Nuclear weapons, as Einstein pointed out, should and must lead to a new way of thinking among human kind. Instead, very little has changed in the thinking of power elites. The best way to have nuclear peace say our tough-minded "realists" is to prepare for a nuclear war. What is more, if deterrence is to be credible, the possibility of a nuclear war at least a retaliation of nuclear attack must also be real. Thus, when governments say they do not believe that there can be any circumstances which justify the launching a nuclear weapons, they are either wilfully lying or caught in an insoluble contradiction. If nuclear deterrence for a country's government is to be meaninful and credible, its willingness to launch nuclear weapons must be real in certain circumstances.

Deterrence, then, is a justification for the proliferation of nuclear weapons. There is both horizontal proliferation (more and more countries becoming nuclear weapons powers) and vertical proliferation (the superpower arms race and the other weapons powers adding to their nuclear arsenals). Both kinds of proliferation must be curbed. Such has been the insane logic of deterrence that both superpowers in the name of "national security" and "deterring the enemy" have embarked upon such a fast moving escalator of arms development and deployment, that both of them have enoromous "overkill" capacities. The end result of this search for nuclear security "has been ever greater insecurity vis a vis each other, and for the world". This is the historical balance sheet of all these years of nuclearly arming in order to keep the nuclear peace.

Finally, with the coming of Gorbachev in the USSR, there seems to be a chance (after three and a half decades of complete barrenness) of the possibility of the superpowers agreeing to a partial and limited disarmament in Europe. But if there is to be an escalating momentum of disarmament then public pressure and mass mobilisation on issues of disarmament must be maintained. The dangers of a new and more dangerous escalation of the arms race in space (star wars) is very much there. There is a vicious circle between the two superpowers that must be broken by external forces such as mass peace movements impinging themselves on the Kremlin and the White House. The superpowers keep on nuclearly arming themselves because they don't trust each other; they don't trust each other because they keep on nuclearly arming themselves.

For various reasons, however, the biggest danger of a nuclear war is not in Europe or the USA or Russia but in the third world where a nuclear war between the superpowers might erupt as a result of an escalating conventional war between allies of both superpowers e.g. in the Korean peninsula between north and south. Incidentally in the demilitarised zone, there are atomic mines and tactical nuclear weapons are available to the American-backed forces of South Korea.

Furthermore, rival countries with a history of mutual antagonism, such as India and Pakistan could also develop nuclear arsenals which would greatly add to the terrorism that already exist. There is already an ever growing lobby in this country demanding that India go in for the bomb now that there is growing evidence of Pakistan having a "bomb in the basement" with the "last wires unconnected". What this lobby wants other people to forget is that India exploded its bomb in Pokharan in 1974 and very likely has its own "bombs in the basement" with the "last wires unconnected". But having some bombs in the basement and openly deploying and progressively expanding one's nuclear weapons system are two different things. It is still possible to step back from the brink as far as avoiding a regional nuclear arms race is concerned. There are thus two levels at which the struggle for disarmament must continue—the global and the regional levels. One must endeavour to halt and reverse both vertical and horizontal proliferation. In the case of India and Pakistan the safest thing to do is not to get into an arms race in the first place i e to mutually abstain from going nuclear. This is what the establishment of a Nuclear Weapons Free Zone (NWFZ) in South Asia would mean. Of course, such a thing is feasible only if both countries want it, whether for the same or for different reasons. Pakistan has expressed its willingness to consider such a zone if India would, because Pakistan equates itself with India and realises that the burden of maintaining "balance" on a constantly escalating regional nuclear arms race would be much the greater fot it. Thus it is in its self-interest and not because of altruistic or "peace-loving" reasons that Pakistan is willing to jointly foreclose the nuclear option.

But India and its bomb lobby is not willing to accept such an "insulting" equation between itself and Pakistan. Thus it is opposed to such regional steps at denuclearisation preferring to argue that unless there is a halt to decline in vertical proliferation of nuclear weapons, there won't be a halt or reversal of horizontal proliferation. This is wrong. Both kinds of disarmament efforts must be pursued and expanded. Limited and partial efforts at disarmament at one level help such efforts at the other level. Both India and Pakistan should forego the nuclear option so that tensions between the two will never threaten a holocaust.

What about "nuclear blackmail" then by other weapons powers? This is a false question. There are three countries that might practice such blackmail. In the case of USSR and USA, the disparity between them and India, even if the latter had a rudimentary weapon system deployed is so great that there is no adequate nuclear riposte or counter threat to nuclear "blackmail" by the superpowers. It is not enough to have a few piddling bombs or missiles. India would have to have a much more powerful and "credible nuclear deterrent" against the superpowers, which it can never have. This is not to say that either the USA or USSR can easily nuclearly blackmail others. In fact one of the biggest problems with nuclear weapons is that their unique nature makes it almost impossible to use them effectively as political weapons. For example, how does the USA use its nuclear might to down Nicaragua and Cuba?

So the only other country from which India might have to fear "nuclear blackmail" is China, which has never been tempted to try any such uncertain process. To establish a "credible deterrent" against China, India would have to embark on a crash programme of nuclear weapons development to make up the 15/20 year technological and deployment gap between the two countries as quickly as possible. Success in such an endeavour is by no means assured. But what can be assured is that such Indian efforts would greatly perturb China and make it more willing to consider nuclear action or the threat of it against India. Such a move would also lead Pakistan to try and nuclearly "match" India and thus enhance the momentum of a regional arms race. There would be greater interaction distrust and histility and above all, greater nuclear insecurity for the countries in the region—more and more insecutiry in the name of the search for security. Nuclear security has to be a *common security* based on the virtues and strengths of disarmament not armament. It is the search for ways to disarm that hold the promise of a safer world not the search for how to use nuclear weapons in the service of national real politic. The greatest tragedy of the nuclear era is the contradiction between the regionalisation/internationalisation of effects and dangers of nuclear war and nuclear arms races and the nationalised

(Continued on p 134)

Health Hazards of Nuclear Cycle

manan ganguli

RADIATION is dangerous. Exactly how dangerous even experts are unsure. The more we learn about it, the more we become aware how greatly the hazard has been underestimated in the past. Karl Morgan, a founder of the health physics profession in the United States, stated, "... there is no safe level of exposure and there is no dose of radiation so low that the risk of a malignancy is zero" in *Bulletin of Atomic Scientists*, September 1978 issue. He further admitted that earlier theories of radiation effects underestimated the damage now being suffered in human populations.

Until 1934, the safe level of radiation exposures permitted to workers in radiation-related occupations was assumed by the scientists to be 52 rems per year. With the growth in understanding of the harmful effects, the level of permissible radiation dose has continually dropped. In 1934, the safe dose for the workers became 36 rem; and in 1950, a new exposure level of 15 rem per year was recommended by the International Commission on Radiological Protection (ICRP) which in 1957 reduced the exposure limit to the current level of 5 rem per year for a worker. However a double standard operates for nuclear workers and for the public—a maximum of 0.5 rem per year for any individual member of the public. And contrary to so much new research that has documented the harmful effects of current permissible exposure levels, ICRP in 1973 has recommended an increase in radiation exposure levels.

In this article, I shall explore the nature and effects of radiation especially low levels of radiation and its relation to nuclear technology.

Radiation and Radiobiology

Everything in the universe is composed of elements—the smallest particle of an element is an atom. The majority of these elements are stable, i e, they do not transform into their elements. Some atoms are unstable and emit particles and energy to transform into newer elements until they have changed to a stable form.

An atom consists of a central nucleus which contains almost all the mass of the atom and which is positively charged; and a surrounding cloud of planetary electrons of very little mass which are negatively charged. Normally an atom is electrically neutral and there is an exact balance between the central positive charge and the surrounding negative charge. The central atomic nucleus consists of two kinds of particles—protons and neutrons—both are very nearly of the same mass but protons have positive electrical charge whereas neutrons are electrically neutral.

Between neutrons and protons in close contact, there are very strong forces which are capable of binding them together into a stable nucleus. The stability however depends upon a rather precise ratio of neutrons to protons. If there are too many or too few neutrons the nucleus will be unstable and will remedy the situation by spontaneously changing the ratio. This can be done in the following ways.

There can be emission of a chunk of nuclear matter called particle which consists of two neutrons and two protons and in so doing the nucleus loses two positive charges. This is radiation.

Alternatively, the neutron can spontaneously change into a proton or vice-versa. In order to conserve electric charge, a P-particle is emitted which consists of an electron (if a neutron becomes a proton) or its positive analogue, a positron (if a proton becomes a neutron). This is B-radiation.

There can also be r-radiation which is a high energy electromagnetic radiation similar to x-rays. As we have seen, a substance containing unstable atoms may emit, B or r radiation by which the radioactive atoms approach stability and the process is referred to as radioactive decay. This is independent of all physical and chemical circumstances and is measured by its physical 'half-life' i e, the time in which one half of the atoms will decay. The half-life may be fraction of a second or it may be millions of years.

This spontaneous transmutation from a less-stable to a more stable state releases energy which is used in propelling the x or B-particles with considerable speed. Being electrically charged, these high speed particles interfere with the electron clouds of atoms through which they pass and change the electrical charge of the atom within a cell by disrupting its structure. This is ionisation.

We cannot sense radiation, it is invisible to the naked eye, we cannot touch, smell or taste it. But a chaotic state can be induced within a living cell when it is exposed to ionising radiation. With the sudden influx of random energy and ionisation, there may be cellular death or varying degrees of damage. This damage can be temporary or permanent.

The delicate but fantastically organised chemical substances in the biological cells can be subjected to a wide variety of types and degrees of injury. Here I shall only enumerate some major consequences. The most catastrophic result which the human body experiences in one generation is probably cancer. The cell nucleus (its store of genetic information) is damaged but the cell survives and multiplies in its perturbed form over a number of years and forms a group of cells that eventually appears as cancer. What happens between the initial radiation injury and the ultimate appearance of a cancer is still a mystery the identification of which is contemporary biology's major challenge.

Damage to Somatic Cells: Chromosomes of the cell nucleus are the targets of ionising radiation. They are considered to carry all the information to control cellular activities like growth, cell division and production of biologically important chemicals like enzymes, hormones. Ceres are the units of information within the chromosome and are composed of DNA. If the ionising radiation displaces one of the electrons in the chemical bond of DNA or RNA, there will be alteration of information-carrying chemical structure in a single gene which in turn misdirects the activities within a cell. There can be abnormal and unregulated cell-division which will produce cancer or leukaemia.

Rapidly dividing cells are more vulnerable to radiation damage. Thus an embryo or foetus suffers most while developing in the mother's womb and may be born with congenital malformation. The cell may start producing a slightly different hormone or enzyme than it was originally designed to produce which in turn may produce millions of such altered cells. This can have many adverse effects on the body such as hastening the aging process, lowering resistance to disease and precipitating psychological stress.

Damage to Germ Cells: It has even more far reaching consequences and may be transmitted to all future generations. We are probably fortunate if the damge to the sex chromosomes is such that they fail to fertilise or if fertilised the unborn baby is miscarried. But with the low level ionising radiation, we are more unfortunate. The health effects upon new generations, carried through mutated genes of human sex cells, are far more serious and pose a maddening threat.

Genetic mutations occur due to natural sources of radiation and other known and unknown causes. They form an equilibrium of beneficial and detrimental genes in the human genetic pool. Indeed, some mutations may be beneficials, but the prevailing genetic opinion indicates that any increase in the mutation rate will create a great deal of human suffering in new generations with serious physical and mental diseases. The detrimental genes if dominant are removed quickly through early death and if recessive will remain indefinitely in the genetic pool affecting generations after generations until they gradually disappear.

Geneticists and medical experts are today of the opinion that major serious human diseases like diabetes mellitus, atherosclerosis and associated heart diseases, rheumatoid arthritis, schizophrenia are genetically determined. They are known now as multigene diseases which comprise over 50 per cent of all diseases compared to earlier single-gene rare diseases like haemophilia, sickle-cell anaemia, cystic fibrosis, etc.

Sources of Radiation Pollution

There are several sources of radiation artificial and natural. In this context, the anatomy of the nuclear fuel cycle will be dealt with to understand this greatest problem of environmental pollution. Yet, other sources of radiation have to be considered with equal seriousness.

Background Radiation: Genetic disorders, diseases and deaths caused by natural radiations are no different from those caused by artifical radiation. It is estimated that 5-10 per cent of diseases due to genetic mutations are by natural radiation.

Cosmic rays from outer space and ultra-violet rays from the sun still penetrate through the present thick ozone layer of the atmosphere though it is much less than what it used to be in the past. They are gamma radiation in nature. Then, some rock strata in the earth containing uranium, radium, carbon-14, etc, release natural radiation and show high incidence of health problems in those areas. The connection between high natural radioactivity of coastal Kerala and higher incidence of Down's Syndrome in that state is well known.

Medical X-rays and Radiotherapy: This diagnostic and therapeutic procedure is one of the artificial sources of gamma-radiation. X-rays emit low level radiation, yet they are not any more considered safe. They have been several studies which have established the connection between X-rays and leukaemia, cancer and other health problems. Drs. Irwin Bross and Rosalie Bertell, analysing X-ray data of 13 million people in three states in the USA, have shown that there is significant genetic damage, large increases in leukaemia and increased susceptibility to infectious diseases as a result of relatively low doses of radiation.

Nuclear Weapons and Test Fall-Out: A 15 kiloton uranium-235 bomb was dropped in Hiroshima in August 1945 killing between 80,000-200,000 people followed by a plutonium bomb over Nagasaki with similar results. Within five years there were increases in leukaemias, cancers and mutation-induced medical disorders from radio-active fall-out. These continued to appear even 22 years after the Hiroshima-Nagasaki bombing. Without going into today's picture of nuclear weapons, it is worth noting that fall-out from test explosions by USA, USSR, France and other countries has polluted the environment with radio-active materials to such an extent that it is comparable to several Hiroshimas all round the globe.

Nuclear Industry and Radiation

The nuclear industry is the major source of artificial radiation which will be polluting our environment for many thousands of years. It is not only the reactor but the whole chain beginning from mining to fuel fabrication to reprocessing of spent fuel and waste disposal that is tremendously dangerous and there is no way of keeping the workers and the public out of radiation exposure even with the normal running of the fuel cycle. It is worth noting here that there is no safe level of radiation exposure.

Mining and Milling: The fuel cycle begins with the mining of uranium where uranium ore is extracted from the rock strata by open cast or underground method. In this process, radium-226 and radioactive gas, radon-222 which are alpha emitters are released. Radon has very short half-live (3.8 days) and is extremely radioactive and when inhaled causes lung cancer. American Indians in USA, black Africans of South Africa/Namibia, aborginal Australians, farmers in France and weaker sections in other countries have been affected most having not only been driven off their land but also having to live near these dangerously polluted mines and by working as miners.

Though the high probability of lung cancer deaths among the uranium miners was well known for a long time, no studies had been conducted until recently. Safety standards and miners' health have been neglected; compensations were denied and experts from the AEC (US) even testified that radon gas levels in the uranium mines were below a threshold level for human health damage! According to US Public Service 1978, out of 100 uranium miners being monitored from one uranium mine in New Mexico, 25 have already died of cancer while still in their forties, and a further 20 are suffering from cancer. In the report of the Australian Atomic

Energy Commission, 1975, the incidence of leukaemia/cancer among white Australian miners has been found to be six times the expected norm.

With the tragic consequences of radon gas and after many unnecessary miner deaths from lung cancer, only in 1967 were safety standards and improved ventilation of the mines introduced in US mines. Yet the uranium mining standards are not and cannot be sufficiently protective of the miner's health.

In the process of milling, i e, crushing the ore finely to extract uranium, radon gas is again released affecting the health of the workers. Milling results in vast quantities of radioactive waste products—tailings—dumped beside the mills without sufficient care. Air, surface water and the ground water are contaminated by the radon gas, radioactive particles and some highly poisonous heavy metals like mercury, lead, arsenic in the tailings. Ironically, in Colorado, they were once used as landfill or building materials for homes, schools, roads, hospitals and an airport. We have very little knowledge about the state of our uranium mine at Jadugoda, Bihar. Proper epidemiological study and health monitoring of the mining community by a team of medical experts, biologists an geneticists is of utmost importance.

Enrichment and Fuel Fabrication: For the fuel of light water reactor (like Tarapur plant), uranium ore has to be enriched to increase the content of uranium-235 by approximately 3 per cent. The process is complex, expensive and uses enormous amounts of energy. There is routine releases of radioactivity to the environment; nonetheless, solid liquid and gaseous wastes are created in huge quantity. Increases in leukaemia rates have been reported in the communities around the enrichment plants. We'll discuss the problem of nuclear waste separately.

Once uranium has been sufficiently enriched, it is sent to a fabrication plant where enriched uranium is assembled into fuel rods for reactor. During the fabrication, there is routine release of radioactivity affecting workers and to the atmosphere permitted as 'acceptable' limit.

Nuclear Reactors: A tremendous amount of heat is generated from the fission of fuel rods and this in turn generates electricity from a steam turbine as in a conventional power station. Nuclear reactors are thus a very complicated and expensive means of boiling water. Apart from the serious radiation pollution, there is thermal pollution and damage to ecological balance as two-thirds of the heat is discarded into the environment. A range of radioactive elements is produced of which only few like iodine-131, cesium-137, strontium-90, plutonium-239, are considered in the discussions.

Reactors are constructed with multiple barriers in order to keep the radioactive release as low as possible and within the containment building. Yet with the stress of heat and pressure, splits and holes occur allowing radioactivity to escape. In addition to occasional serious accidents, there is routine release of vast quantity of radioactive waste from the nuclear reactors. Of the radioactive elements produced in a nuclear reactor, plutonium is the most toxic with a long half-life of 24,000 years. Single particles weighing one-millionth of a gram, so small that they can only be seen under a microscope, can cause cancer of the lung if inhaled. Apart from causing cancer, it is concentrated by the testicles and ovaries where it will inevitably cause genetic mutations which will be passed on to future generations. Yet each operating nuclear reactor produces between 400 and 600 pounds of plutonium each year in its normal operations. Strontium-90 chemically resembles calcium and is absorbed by bones and causes bone cancer and leukaemia, Dodine-131 concentrates in the thyroid gland to cause thyroid cancer.

There have been several studies by the radiation research scientists and medical experts to evaluate the hazards of radiation at the workplace. Perhaps the most extensive study yet undertaken was that of Thomas Mancuso of the University of Pittsburg at the Hanford Atomic Works in USA. This study was independently analysed and assessed by Alice Stewart and her assistant George Nkeale, a mathematician. Stewart, a medical expert from Birmingham, had first documented the health effects of low level radiation of medical X-rays on the human foetus. Mancuso-Stewart-Nkeale study evaluated astonishing results of cancer and other radiation related hazards of Hanford workers; and US authorities terminated Mancuso's funding for follow-up study and there were even attempts to confiscate his Hanford data. Mancuso concluded that the dose required to double a person's risk of cancer *is less than half the internationally accepted limit (33.7 rad against nuclear industry's estimate of 500 rad exposure)*. Unfortunately, all these studies are yet to make an impact on the industrial and military nuclear world.

Reprocessing: In reprocessing, spent fuel rods are broken open and outer cladding is dissolved in nitric acid to separate plutonium and unspent uranium. The plutonium is separated out for use in nuclear weapons or for fuel in a breeder reactor. The process is extremely hazardous and apart from the release of highly radioactive gaseous and liquid effluents, releases routinely nitrous oxide to the air causing acid rain. There is severe occupational threat to health in reprocessing facilities and also serious environmental threat due to production of highly toxic radioactive waste.

Reprocessing has more or less been abandoned in US. Commercial reprocessing plants there have been shut down for years due to faulty technique and excessive contamination. The large reprocessing plants in operation in UK (Windscale) and France are no exception regarding radiation contamination and risk to the workers despite claims by the authorities of safe running. Besides, the Irish Sea and the surrounding environment have been heavily contaminated because of routine dumping of waste produced at these plants. The actual situation at the reprocessing plant at Tarapur is not known; it is said that the plant is inoperative due to contamination.

Waste: As we have seen, nuclear fuel cycle generates vast quantities of radioactive waste at all stages. They have been divided into three categories—high, intermediate and low level, by the concerned international and national authorities. Low level wastes are considered as a low hazard potential. Referring to earlier discussion, it appears that a 50 per cent increase in genetic disorder and diseases are considered by

(Continued on p 123)

Don't Just Reduce Risk—Transform It!

dave rosenfeld

In order to ensure a specially high degree of safety, the job was so highly compartmentalised that those in different departments often could not or were not allowed to communicate with each other.

—Robert Jungk, on the Cap de la Hague reprocessing plant, in The Nuclear State

It would be possible to write a history of the inventions made since 1830 for the sole purpose of supplying capital with the weapons against the revolt of the working class.

— Karl Marx, Capital, *Vol 1.*

THE arguments for nuclear safety have become familiar: 'The risk from a radiation does of 1 rem is the same as the risk of being obliged to smoke 1/20th of a cigarette every Sunday', claims Walter Marshall, chief of the Central Electricity Generating Board (*Atom* October 1982). Independent studies conclude that nuclear electricity in the whole fuel cycle gives fewer deaths per unit of electricity than does coal (see Table in Appendix). The argument appears absurdly simple, yet anti-nuclear objectors get locked into a debate on the exact level of risk from reactors, reprocessing plant, transport bottles, dumped nuclear cargoes and nuclear disposal sites. Hiring experts to challenge the well-funded orthodoxy is expensive. Counter-experts are marginalised from the 'scientific community' and are denied even minor funding. Some, like Professor Sternglass, have been crudely attacked as 'fearmongers'. Some scientists find themselves moderating the objectors' 'overreaction' as they see the risk as numerically low, even if it is really at double or treble the industry's risk figures. For the anti-nuclear side the debate is demoralising and endless.

But there is more at stake than simply challenging the true numbers of deaths due to each technology. The very idea of quantitative 'risk' contains hidden assumptions that influence not only the style and outcome of the debate, but also the detailed choice of technology by industry's managers. This article will draw out some hidden assumptions and challenge them. I end by showing that this is not merely word-play, as the analysis gives useful perspectives for a number of radical science issues, not least nuclear safety.

What is This 'Risk'?

Risk determination is used by the nuclear industry in all its safety cases to marshall safety information, from a number of disciplines, into figures of expected deaths, accidents or disease per reactor, per disposal site, per unit of electricity, etc. For the initial breakdown of equipment, elaborate engineering models ('fault trees' and 'event trees') are used in what's called 'probabilistic risk analysis'. For the spread of contamination, environmental modelling is used. For the effects of radiation on the exposed workers and residents, toxicological models (of 'dose-response') are used. It is not claimed that the models yield causal predictions. Rather they give a figure of risk that is said to give the chance of harm from nuclear power, or from coal when applied to coal. The calculation of risk figures use disciplined methods and are arguably worked through with a degree of scientific rigor often lacking in safety analyses. Yet the actual notion of risk, defined as 'probability of harm', has so far gone unchallenged. And it is precisely this notion, when it is analysed, that turns out to be the vehicle of prevailing prejudices about technology.

Hidden meanings can be seen once we ask why 'risks'—seen from presentations of tables of deaths, in say coal, nuclear or other industries—always seem so fixed. These figures, we are told, represent the risk of an industry, or rather, it is implied—and this is the crucial unspoken step—the hazards *due to the technology* alone. Thus the 'risk' of nuclear power is 1 death in a million people per year. When risk analysts look at average accident rates over decade periods and claim that, on current improvements since 1940 in the coal industry, mining deaths will be down to 0.3 per 10,000 per year by 2000, it reinforces the inevitability and asocial character of risk. It is simply the 'risk of a technology'. We can only wait for the technology to become safer.

This kind of fatalism is reinforced by a risk analysis that excludes the social relations of hazards and so makes risk into a thing, as an inherent, technical property of a particular technology. This definition of the problem serves to relegate 'decision-making' to elites acting on behalf of potential victims. In particular it uses 'risk reduction' to justify supplanting older skilled technologies with supposedly 'safer' ones (coal vs nuclear), or adding on extra 'safety devices to dubious designs for nuclear technologies (British-style PWR for Sizewell).

The prevalence of risk analysis (or 'risk determination' as they call it these days) in the Great Nuclear Debate raises some important issues for the politics of science. Its use is based on the idea that risk is due to a technology and measurable as probable deaths per year. This idea rests on several definite assumptions, rarely spelled out: 'risks' are *in* technology, asocial, randomly striking and quantifiable. Once having analysed these assumptions we will see the dangers of being led to tilt at technology, and of acutally inviting greater managerial control of work via the choice of the 'least risky' technology.

The assumptions that lie behind risk as the 'probability of harm' are as follows:

(1) *The calculated risk is due to the technology alone* (in the sense of 'hardware'). Thus the risk figure is applicable with the same technology to Britain and Brazil, to 1983 and 2003, to managers and workers.

(2) *We are 'exposed' to risks that strike from within the technology; the probability of harm is the probability of being hit.*

(3) *The risk is randomly striking.* For the use of probability:

a) The specific hazardous encounter with technology is identical every time.

b) The risk *exists* in every encounter, but it only *strikes* with harm as the 'outcome' in a few cases, entirely at random.

c) This randomness gives rise to the fluctuations around an average number of people struck per year, as a hand might draw differing numbers of peas from a black bag, but always approximately a handful. It is the average number of deaths that is measured by probability.

(4) *The quantifying of risks makes all activities comparable.* The essential part of this 'risk' is its numerical level. Once that is known, the essence of the risk is grasped. Otherwise incomparable activities can then be compared by ranking them on a scale.

The current use of risk analysis, then, leads us to a particular view of the structure of hazards—risks are asocial, they are external, they strike randomly. If the construct of the risk analysts is to be believed then we are surrounded by randomly-hitting techno death-threats. Is it some kind of macabre prediction when we are given the retort, 'Well, *everything* has a risk?, Is it a wonder that analysts speak of people as being risk-averse?

Safety Science Is Dangerous

How valid is this description of hazards given by risk-analysis? We shall look at its assumption. Some are easily debunked, while others are more subtle.

(1) *Is risk due to technology alone?* For workers from a workforce to die year in, year out, in similar numbers, they must be born, fed, clothed, transported to work, trained, ordered, paid, put in hazardous situations, kept healthy or replaced. In short such statistics require that the whole system that gives rise to the hazard is reproduced. Mortality and morbidity figures for industries, then, do not simply measure some 'technological risk'. Rather, they measure the overall *social reproduction of industrial harm*. That is, they measure social and economic forces that bring people into contact with hazards as much as they indicate any intrinsic hazard of working with the hardware. Accepting the false assumption leads to a false strategy. Attacking technology as the cause of the intolerable hazard will only solve half the problem—you must attack the forces bringing the technology into being, or else a substitute for the same purpose will be found.

(2) *Is risk a thing that 'exposes' and strikes us from within technology? Do risks always strike at random?* These questions are linked by the idea of an alien threat hitting in an unknowable way from outside our experience. Are hazards in essence randomly striking alienated threats? The answer is not straightforward: yes or no. At one level, some hazards do strike randomly. For example pipe breaks in complex plants carrying toxic materials are due to metal fatigue or mechanical failure that is basically a random process. Likewise the effects of exposure to agents like radiation, viruses, invisible asbestos fibres occur in individuals in a way which is governed by random biophysical events.

However, the assumption is false at another level—that is, at the level of individual or collective control over a hazard. Take the case of detailed control by operators over a task. To speak of the 'exposure' to the risk of cutting your own finger with a chisel (assuming the blade is perfect) would sound odd to the skilled craft worker. The ordinary risk of a cut finger is not random to the woodworker since it arises at well-defined times when care can be taken to avoid it. It is the term 'skilled' that we associate with remedial actions being on a human scale, where the 'exposed/at risk' categories would misrepresent that control.

In the case of collective control, information on workplace organisation can transform the nature of risk. For example, ask a worker at the Windscale nuclear fuel reprocessing plant to repair pipework in a high-radiation area unfamiliar to him. Even if there are only a couple of lethal 'hotspots' where doses are high, the whole area appears hazardous. To him (women are not employed in high-radiation zones) a walk in a straight line is like crossing the road blindfold. As the management gives him a chart of hotspots and a pocket alarm meter, he feels sure to avoid deadly spots, confidently and consistently—as long as experience tells him the management or union safety committe have assured the chart meter are reliable.

In this example, if two areas had the same death rate, it would be preferable to work in an area A (most of which had lethal hotspots but where you're given accurate, trusted information) than in an area B (with very few lethal areas but no clue where they are). If some workers have died in areas A from carelessness, it seems less of a problem to negotiate than if the same number died in area B from a withering beam by bad luck. *The randomness of the risk depends on workplace relations.* So at one level there are indeed randomly striking hazards e g, cancer risks from radiation, viruses, chemicals. At another level hazards are subject to detailed control, so that harm is due to bad design, bad procedures, poor training, poor information or carelessness, e g, woodcrafting and work in 'hot' radiation areas.

(4) Quantification adds no further assumption that is not already made in the earlier points. However, the acceptance of such numbers as inherently comparable serves to hide the assumptions that we've identified.

By assuming that all hazards are randomly probabilistic, risk analysis treats people as passive objects of technological hazards: individual and collective consciousness are ignored. The immediate consequence is that, in general, *strategies to reduce 'risk' evade the issue of control over safety instead encouraging a 'lower risk' technology that is alienated from worker and community control.* The problem is not too little management attention to safety analysis, but too much. The quantitative comparison of different risks encourages deference to the intrinsic 'risk of a technology' and thus to management control over safety.

Historical Origins of 'Acceptable Risks'

How does 'safety' get reduced to a technical choice among different technologies or different devices within a technology? This is done so compellingly by risk analysis by quantifying risk as the probability of harm, yet while hiding the assumptions involved. The 'nuclear is safer than coal' argument, then, involves more problems that the simple, hopeful predictions about nuclear accidents and health damage from radioactivity. More insidious than that, the whole framework treats the harm from each industry as technical, fixed, while at the same time pretending not to make value-judgements. Ironically, this type of risk-analysis arose from an historic admission of 'no safe level'. Let us see how.

1966 was a turning point for risk analysis. The International Commission on Radiological Protection (a self-appointing, non-governmental body) accepted that radiation may have no safe level of exposure for cancers and genetic defects. Secondly, in that same year a fast-breeder reactor near Detroit burst a fuel pin and partially melted down, thereby exceeding its official 'Maximum Credible Accident'. The safety engineers quickly realised that automatic safety devices can and do fail, so that there is no accident that could be made strictly impossible by engineering safety features. So by 1967, both in toxicology and in engineering, it could no longer be assumed that risks had a 'safe level' that could be found scientifically.

Since the acknowledgement that some hazards have no safety level, new theories of how to predict risks from drugs, rays, bugs, chemicals machines and industries have arisen together with social theories of how to resolve conflicts over safety. One model, popularised by W W Lowrence in 1976, particularly captured the minds of researchers. It appeals to the administrator role of professionals in the scientific/industrial/managerial world. In this view:

i) Everything has a risk—most agents, technologies, occupations, leisure. The magnitude of this is a technical judgement for scientists.

ii) Scientists should rightly avoid statements that something is 'acceptably safe', which amounts to a political judgement.

The view is articulated as follows. No longer can scientists simply show that risks are non-existent and then reassure the union, the patient, the plaintiff or the tenants association. As risks always exist on a numerical scale, a safety standard represents some level of hazard. So someone (society, not the scientist) must either ban the technology or set an acceptable level of hazard, given the benefits of the technology. In effect scientists purport to present simply the facts and then allow others to set 'acceptable risks' within that rigged framework.

Faced with a new technology, or a newly contested one, scientists must now find the objective level of risk from a whole range of exposures. A new science, *risk analysis*, was painstakingly developed, supposedly to give a predicted sliding scale of risks from different levels of technology. This scale was to be input to *decision-making*, where conflicts are resolved by choosing to expose people to a level of risk which is outweighed by the benefits from the risky technology. The decision-making could operate 'rationally'—that is, by using economic arithmetic to spend the limited safety and health resources in proportion to the level of risk.

However, decision-making will be bedevilled by the need to make expedient decisions because, so the model goes, the level of risk people tolerate and the vigor of opponents to risky projects is not in proportion the 'objective risk', as ascertained by risk analysis. People (not the numbers) must be wrong, ignorant, vindictive or irrational. Decision-makers therefore need a second input, apart from risk analysis, namely a socio-psychological study of why people's reactions do not correspond to the objective level of risk.

This whole view, originating in the nuclear and aerospace industries, was seen as the proper way for scientists to set about denying adjudicating on 'acceptable risk'. And, so it appears, scientists could voluntarily abdicate the politically-laden role of reassuring on safety (if only they would!) and could instead retire to the rigorous and objective world of toxicology and safety engineering methods in the new science of risk-analysis. Appealing though this scheme is, however, it has been openly admitted that risk analysis is not entirely objective. And this admission has jeopardised the credibility of 'rational' decision-making and socio-psychological studies of people's irrationality toward risk.

For example, in developing measures of the risk of an industry, risk analysis has used various ways of combining the incidence of different accidents and diseases into an index that would measure the total amount of harm. However the conclusion became inescapable that, where these grand indices were used, risk analysis was making moral judgements. For example, if we simply add days of work lost from different diseases per year, we make judgement about the relative amount of harm from physical versus mental suffering, suffering long versus dying early, frequent isolated deaths versus infrequent mass-killings.

To avoid making such obviously moral judgements, practitioners decided not to aggregate diferent forms of harm. The disciplines of safety engineering and toxicology can systematically analyse failure rates of machines and arrive at does-response curves for toxins. Mathematical formulae then come out with probability of harm per year for *each type* of injury or disease separately. It is these well-defined methods, usable by anyone, together with the experimental data and industrial accident data, that supposedly make risk analysis figures objective. It is only by a detailed look at the definitions of risk (as in the previous section) that we were able to get to grips with this last formulation and understand precisely how risk analysis is value-laden.

Practical Consequences

Risk analysis lies at the heart of the prevailing idea of acceptably risky technologies. Debunking it (i) is useful in general radical science perspectives, (ii) informs some perplexing questions for anti-nuclear campaigns, (iii) opens up an approach for opposing safety analyses that use probability and (iv) facilitates intervention in the 'risk debate'.

Firstly, we have worked through an example of how science clearly acts as ideology. The scientific content—here the very definition of 'risk'—is the vehicle of the manager's right to dominate workers' activities. New questions arise: Should socialists abandon entirely the elaborate and rigorous methods of engineering risk analysis? Is there a socialist science of risk? Will the simple expedient of stating the social relations of (quantified) risk overcome the objection?

Secondly, we can see how the dominant managerial definition of nuclear safety fits well into the wider nuclear project. Although nuclear energy will not deliver any net *energy* until after the turn of the century—due to a net consumption during the construction part of the programme—it could generate 30% of *electricity* by 2000. That is much more than nothing at times when transport workers or miners block the remainder.

> . . .a nuclear programme would have the advantage of removing a substantial proportion of electricity production from the dangers of disruption by industrial action by coal miners or transport workers.
> —leaked minutes of Thatcher's Cabinet Sub-Committee on Economic Strategy, October 23, 1979 (originally published in *Time Out*)

Nuclear safety systems
—require often intense workplace discipline, e g, the restrictions on internal communication at Cap de la Hague;
—require no-strike agreements to achieve their assumed performance; and
—rely on highly qualified scientists whose work and attitudes are highly integrated into management perspectives.

Risk analysis, portraying risk as a neutral quantitative matter, paves the way for work organised under nuclear managers' discipline, even blackmail, all in the name of *more* safety. Is it not preferable to back coal, where a knowledge and control of the system by workers give higher chances of winning a better safety deal than with the polutonium state? What guarantee is there that current nuclear safety standards will not be eroded when the Tory government has further cowed workers and other opponents with nukes? Already Reagan has been declaring the nuclear industry to be 'over-regulated', and promising side-steps to licencing hearings.

As scientists are involved in designing and assessing technologies, they should be aware that their work influences the relations of control. When people reject 'dread hazards', this is not simply a matter of their ignorance of 'the true risks', but a sign also that no trust has been built between people facing hazards and those in control. Sometimes distrust comes from consistently negative experiences, as many shop stewards in industry will testify. But in other cases it is a sign that there is no consistent experience that people can rely on. In short, there is a gulf between people's experience of technological change and scientists mostly aligned to managerial priorities, as defined especially by risk analysis. It is this class nature of scientists role, and not some fundamental irrationality of people, that generates hostility to new hazards.

Thirdly, is it possible to challenge nuclear science as science? The technical literature clearly paints the picture of a systematic safety programme that's the envy of chemical safety campaigns. Time and again the literature asks whether this effort is 'enough'. It seems a logical definition of the problem. Yet once we are in the thick of the numbers game, it is hard to challenge the expensive and extensive studies that show nuclear power as 'relatively safe' or 'about as safe as coal'. Most critics stick to the general issues of the politics of plutonium, rather than wade through the swamp of reactor science, radioecology and radiotoxicology. There has been no analysis that criticises nuclear science as a starting point for identifying the problem. Our analysis removes this quandary. By analysing the precise use of probabilistic risk, we can argue specifically on the science of safety and win! That is, we can expose the class base of the technology by dissecting a key scientific concept, quantitative 'risk'.

Lastly, radical research on safety is given a new focus by this analysis. We've discovered that the key debate is not

Low-Level Radiation – Out of Control

Workers at Windscale experience, by and large, a comprehensive programme for avoiding the 'hot-spots'. This programme has engendered a basic confidence that risks are under control. At the plant, workers are understandably quite defensive when 'outsiders' allege that their work is dangerous, as they find themselves identifying with management on the safety issue. This attitude affects relations over the low-level exposures. With low-level radiation, in contrast to the high-level situation, there is no alternative to an intrinsically random. untouchable, unknowable hazard. You do not even know whether you have been affected until twenty or so years after the event. Routine, random low-level exposure is tolerated in the knowledge that the chance of harm per person is very remote. But this 'knowledge' is chimerical and entirely different from daily witnessing a competent hot-spot management operation. For low-level work, badges are issued and exposures tallied, but the knowledge of the hazard is available only from scientific studies. BNFL's interpretation of the studies is accepted. This acceptance might he seen as a spin-off from the confidence won from their track record in hot areas, their vindication by 'independent' Government bodies and their success in dealing with scientific challenges in the press and at inquiries. As BNFL win this confidence game, the scale of low-level radiation risk remains uncontested as a workplace issue. (What has been contentious is the administrative practice of 'burning out', or exposing unruly workers to the yearly maximum allowed radiation, thus disqualifying them from further work in the year—but this is not directly linked to the 'randomness' issue.)

This historical aquiescence by most workers, on the lower-level exposures, should not distract from the very different relations of control. With high-level exposures, concern is highlighted when for example a direct injury occurs, with visible effects within hours or days. The response is obvious: press for effective measures to prevnt any repetition, with whatever muscle you have. With low-level exposures, your concern over getting a cancer or deformed kids is heightened only by claims that the old risk-estimates are wrong, that it's more dangerous now. Workers don't control science; the pronouncement could appear to come out of the blue unless you have reliable information from scientific allies. And you have already been exposed; you cannot change that fact. Without those scientific allies with a proven track record, the choice is between management's reassurance and abject worry. Thus the class role of scientists is crucial.

about the level of risk from Sizewell B's proposed PWR. The numbers used in risk analysis talk only about the hardware failing. When operators are mentioned, the chance of 'operator error' is used entirely as if operators were hardware, albeit defective. At nuclear plants we must expect that the real failure rates will be dependent on the social system that organises it:

Real responses of thinking, waged operators
—Workers may be on strike in a minor accident sequence.
—Management commitment to a training programme may lapse.
—Complex but infrequent modes of failure may happen in too short a time for anyone to cope.

Smoothly running quality assurance programme
—Subcontractors may falsify quality inspections (and have done so).

Smoothly running maintenance programmes
—Non-unionised temporary maintenance workers may rebel against 'burning out' practices.

Effective inspection programmes
—Inspectors close to the industry may be lax, believing risks low. (Hendrie, chief US regulator, was sacked after Harrisburg.)

'The techbology'
—Like each car, each reactor has its own unique history of construction and maintenance.
—When politicians like Reagan (or an 'over-regulated' industry) change standards, the PWRs built and maintained may be different.

In non-nuclear safety there is an increasing tendency to follow the assessment methods developed in the nuclear energy debate. In fire safety, asbestos control and chemical plant safety we see use of 'cost-benefit analysis', 'reasonably practicable reductions', 'engineering risk assessments'. These all rest on the idea of balancing costs of reducing 'the risk' against supposed benefit of using the technology.

There are many obvious questions to raise about these schemes: Who benefits from the product? How do you measure the cost of life? Our approach goes further by challenging the scientific definition of 'the risks' that were measured in the first place and that were assumed to exist in the technology as a thing, not as an organising system. Through our approach, the question of control over the risk can be made central to the debate even before monetary costs are raised. Indeed, the particular social construction of nuclear risks turns out to be less a cost than itself a benefit to nuclear management.

The numbers game has often led environmentalists and hazards campaigners into a blind alley of demanding 'zero risk'—an idealistic and unrealistic focus. This quandary points to the real difficulties with either rejecting or accepting a (supposedly apolitical) 'balance' between health 'costs' versus industrial 'benefits'. That kind of choice usually confronts us as utterly compelling, universal rational. For example, could socialist societies delay reconstruction programmes until all industry is conclusively proven 'safe'? Our approach offers a way out of the quandary: while defending the primacy of health, we can assert the issue of control as central to any 'acceptability' of hazards in the name of wider benefits.

In conclusion: Beware the 'low-risk' technology of safety science, which serves to usurp control over hazards and thus guarantee management's safety from workers. The important safety question facing workers and communities is not some precise, numerical level of safety. Rather it is how we can gain detailed control over deciding which risks we take, so that we are confident, at all times, they're worth the benefit. How do we transform alien hazards?

[Reprinted from Science Radical Journal 1989.]

(Continued from p 118)

the international atomic energy authorities as a small hazard.

Safe management of radioactive waste is an unanswerable problem of the age because toxic products are not only highly lethal but remain radioactive for several million years. The more we go nuclear, the more we are adding to the problem of survival of our future generations.

There have been some romantic suggestions disposing of toxic waste from the earth by rocket into space or deep burial under the Antaractic ice but no adequate solution has yet been devised. Uptil now only high level radioactive wastes are stored in carbon or steel-concrete tanks which last 30-50 years; and low and intermediate level wastes are either dumped into the sea or buried underground in concrete silos. Proposals bave been made to solidify the highly toxic waste in glass blocks to be stored in shafts drilled in the seabed or under hard rock.

All the attempts and plans are far from reaching any real solution. There have been leaks from the storage sites contaminating the surface and ground water and the atmosphere and causing serious health hazards. We know very little about India's waste management programme.

The operation of a nuclear reactor generates astronomical quantities of radioactive waste of different types and of varying half-lifes ranging from a few seconds to a few thousand years. The amount of radioactivity produced from these elements is in direct proportion to the operation of the reactors. Even after Chernobyl which has put a big question mark on the future of nuclear power, India's nuclear policy is unchanged. We have an optimistic plan of 10,000 MW electricity from nuclear plants by 2000 AD! It is estimated that one year's operation of a 1000 MW nuclear plant generates fission products equal to that of a 23 megaton fission bomb; that is more than 1,000 bombs of the Hiroshima size.

Safe, permanent and absolute isolation of these radioactive poisons from the environment is the only condition for nuclear power to be acceptable. And this is simply not realistic. There is no disagreement today about how much radioactive poison is produced by the nuclear power plants. There is little or no disagreement about how lethal these poisons are. The disagreement lies in the quality and quantity of routine release of radioactive elements during all steps of the nuclear fuel cycle. Will the nuclear advocates give a satisfactory answer to this? No, they cannot and will not. The only answer is:

STOP NUCLEAR POWER

The Numbers Game

Occupational Health Hazards at Indian Rare Earths Plant

v t padmanabhan

The Department of Atomic Energy is currently pushing forward its ambitious plan involving a ten-fold expansion of nuclear power generation by the year 2000. This would involve the setting up of a number of nuclear establishments and would expose a number of people, workers and neighbouring communities to varying degrees of excess radiation. The Indian Rare Earths is the only DAE venture which has completed 30 years of operation, which incidentally is the average latency for cancer which is just one of the health hazards of exposure to radiation.

This paper (condensed from the Economic and Political Weekly, *March 8-15, 1986) reports a retrospective epidemiological study of workers at the Rare Earths Division of the Indian Rare Earths Limited, Alwaye in Kerala. The study examines the mortality profiles of workers for the last 15 years. Workers at the nearby Travancore Cochin Chemicals and those insured with the Employees State Insurance Corporation are taken as the control populations. The study demonstrates a significant difference in the incidence of cancer and mortality due to heart diseases and all causes between the IRE workers and the control populations. The incidence of sterility among the IRE workers and genetic disorders among their children also appear to be high. However, a study of this sort can only formulate a clinical hypothesis. There is an urgent need to institute a comprehensive, inter-disciplinary study of the plant and the workers. Such a study cannot unfortunately be conducted by independent workers or research centres because the Atomic Energy Act of 1962 prohibits any such inquiry into the affairs, including health and safety issues, of the DAE.*

AN Occupational Health (OH) study involves the use of multidisciplinary techniques of medicine, environmental science, social science and law. To be complete, the study should focus on the health status of workers, quantify the pollution load in the work environment and study the health and safety apparatus available including the internal safety organisation and compensation structure, etc.

In this paper, an attempt is made to study the health status of workers of Rare Earths (RE) Division of the Indian Rare Earths Limited (IRE) Udyogamandal, Ernakulam, Kerala. IRE, an undertaking of the Department of Atomic Energy (DAE), is engaged in the processing of monazite sand found in abundance in Kerala and Tamil Nadu coasts. The plant under study has a processing capacity of 4,000 tons of monazite a year. The main products of IRE are thorium, rare earths (RE) chloride and zirconium. Thorium is at present used in the production of gas mantles. The metal, which derives its name from Thor—the Scandinavian war god—would be used as fuel in breeder reactor which is still in research stage. Zirconium is used for cladding of uranium fuel pellets for atomic reactors. The other important product—RE chloride—is used in the chinaware industry. India commands a share of one third of the world market for this product.

The Health and Safety Division (HPD) of the Bhabha Atomic Research Centre (BARC) under DAE is entrusted with the sole responsibility of health and safety of workers in units under DAE. The Atomic Energy (AE) Act, 1962 prohibits an independent scholar or a research centre from making any inquiry into the affairs of the DAE, including the health status of its workers.[1] Even though the DAE units employ more than 20,000 people, no data regarding workers' health status is available, except, of course, occasional briefings to the press made by the official spokespersons.[2]

In this section, the production process at the plant under study is described briefly and an attempt is made to identify some of the more hazardous locations found on visits to the plant.

The main raw material used is monazite which is an orthophosphate of 15 rare earth elements and thorium. The sand is ground in the ball mill to 400 mesh size after which a suction pump pulls out fine dust through a filter and deposits it in a bin. Dust is then mixed with dilute caustic soda (lye). The solution is then pumped into the attack tank where caustic soda (flakes) is added. The solution is then moved to arelay tank and leached with water. The first product of the process—Trisodium Phosphate (TSP)—a general purpose detergent—is decanted here.

The remaining slurry containng hydroxides of rare earths, thorium, uranium, mesothorium and lead is pumped into a set of 'More Filters' where it undergoes filtration and washing. Traces of phosphate are removed and slurry is pumped into four extraction tanks where concentrated hydrochloric acid is added. At this stage, the RE fraction of the compound becomes RE chloride which is drained out and pumped into a deactivation tank in which barium chloride and sodium sulphate are added. Deactivation involves separation of radioactive elements like uranium, thorium and their 'daughters'. These as well as lead are then allowed to precipitate in the tank. The precipitate is mechanically separated through press filters. The clear solution which is pure RE chloride, is decanted and the precipitate is scrapped off the press filters manually. Thorium hydroxide is also sent to another set of press filters to remove traces of RE chloride. Thorium hydroxide is scraped manually and pumped into a silo.

While no spot in the IRE compound seems to be free of radioactivity, there are a few processes which involves considerable threats to the workers. Let us consider a few examples:

(a) *Ball Mill*: The mill where monazite is ground is not air tight. There are numerous holes through which dust can escape. Moreover, mill vents have to be opened frequently for sample collection. This is done manually by the operator/helper. Though respirators are given, the workers do not wear them because: (i) it is uncomfortable; (ii) since a worker has to attend three spots, it is inconvenient; and (iii) since the volume of air breathed is reduced considerably, the worker is not able to cope with the work-load.

(b) *Filter Press ('Cancer Ward')*: At filters where thorium and mesothorium are pressed into cakes, materials handled are richest in radioactivity. Here work is done in pairs, each worker standing on either side of a $10' \times 2'$ rectangular press, with a series of wooden frames. The top of the press is at chest level. The sticky concentrate has to be scraped from the frames using a metal sheet as big as a kitchen knife.

Workers on this job are given gum boots and rubber gloves. On the day of our visit, one of the two workers was not wearing gloves. He said that with gloves, the speed of work is reduced considerably. The plant superintendent who accompanied us did not ask him to use the 'protection gear' either. Mesothorium has gamma activity. Rubber, in any case is not a shield against this.

(c) *Lead sulphide disposal*: Lead sulphide (which contains lead, mesothorium, etc,) collected in the RCC barrels remains unsealed, for a week. The barrel is located by the side of a road leading to the canteen/dispensary. They are sealed once in a week. After a year or so the barrels are buried in the factory compound itself by a disposal team consisting of a crane operator from the Fertilisers and Chemicals Travancore Ltd (FACT) and contract workers. The latter have to remain close to the barrel for securing its hooks.

According to the International Labour Organisation (ILO) guidelines, this class of radioactie waste can only be handled in "sealed-in operations, with people working in plastic suit with controlled ventilation".[3] In IRE, workers wear only cotton khakhi uniforms.

(d) *Thorium Silo*: Wet thorium hydroxide, kept in silos is removed occasionally for transportation to the Trombay facility. (This is a Government of India-owned company which is under the management of the IRE. Here, thorium hydroxide is converted into thorium nitrate for gas mantles and thorium oxide for research purposes.) Since silos contain many hundred tons of thorium stored for over three decades, there is the possibility of a high concentration of thoron, a thorium 'daughter' in gaseous form. According to ILO, air in the silo has to be evacuated once in every 17 minutes.[4] There is no facility for this in IRE. With radionuclides and thoron gas, work in the silo can be equated to both a radiation bath as well as a radiation dust bath.

(e) *Open Vessels*: Almost all chemical treatment is carried out in open vessels. Spillover of considerable vintage has accumulated all over the vessels. Because of the openness, radionuclides and thoron gas float freely in the workplace. In almost all processes, the external skin contamination is totally unavoidable because of the bad housekeeping. According to the plant superintendent the vessels as well as the floor, which appeared no different from a paddy field during transplantation had not been cleaned for over a decade. While the above hazards are of a day-to-day nature, there are riskier operations which have to be performed periodically. Some examples are given below:

(a) *Digging the Pond*: After extraction of TSP, the remaining slurry is washed in three tanks. The slurry is moved from tank to tank with an electrically-operated crane with a maximum capacity of five tons. At times, when the slurry is beyond the carrying capacity of the crane, or due to some other faults, it has to be removed manually. Workers, usually new recruits, enter the tank with a shovel. They can wear their gum boots and rubber gloves, if they wish to. The slurry is removed with the shovel and this job is known as 'kulam vettal" which, in Malayalam, means digging the pond. The approximate frequency of this event is one a month. The tank contains hydroxides of rare earths, thorium, mesothorium and uranium which have alpha, beta and gamma activity.

(b) *Digging the Grave*: Lead sulphide, the main solid waste, which contains mesothorium and other radioactive materials, is stored inside an RCC barrel which can accommodate 200 kg, the approximate output is more than normal, excess quantity bulges out of the polythene bag kept inside the barrel and is removed manually with a shovel. This has to be done approximately once every month. The materials have beta and gamma activity.

(c) *Occasional Activities*: Apart from these, occasional activities like shifting of godowns are done by contract workers. During 1983, dock workers of Cochin were employed to remove thorium concentrate stored in IRE godown near the port. According to an eyewitness, many of the MS drums in which the concentrate was stored were corroded and broken. During January/February 1985, casual workers were employed to shift thorium produced during he early fifties to the present silo. No protection was given in the above cases.

Among the permanent employees, the exposure rate is not uniform for all categories of workers. While helpers remain in close proximity of the production process, operators and supervisors who do not have to do much of a manual handling, remain a little away from it. However, the management has made it a point to evenly distribute hazards among all the workers. This has been achieved in two ways: (i) In IRE, there is only one entry point for workers, they are recruited as helpers. The posts of operators and supervisors are time-scale-promotion based; (ii) After a complete monitoring of the plant by HPD in 1966, permanent posting of workers to separate sections within the production line was discontinued. A rotation system was introduced under which every worker moves out of one section after a fixed interval.

The production technology was imported from France where it was developed in the forties and is outdated by nearly half a century. During those days, the awareness of radiation hazards was at a very low ebb, restricted as it was to a few radiologists. Between then and now, developments of a far-reaching nature have taken place. In IRE, however, the increased awareness of radiation hazards has not lead to any innovation to prevent it at source. Instead, cheap and totally inefficient measures like gloves and gum boots have been resorted to.

The Numbers Game

In a latter addressed to the Prime Minister April 15, 1985 Professor K V Thomas, member of the Lok Sabha from Ernakulam, alleged that 14 workers of IRE died of cancer between 1970 and 1984. The prime minister in his reply (April 23, 1985) promised that he would have the issue examined. Earlier, in a memorandum addressed to prime minister, all the recognised trade unions of IRE had pointed out that the high incidence of cancer among workers can be attributed to radioactivity.

In our review of literature, we saw that the cause-effect relationship between radiation and diseases like cancer, genetic disorders, etc, has been well established. However, these diseases can also be caused by agents other than radiation. There is no way to ascertain the initiating factor in carcinogenesis at present.

Since occupational diseases do not carry a label indicating their origin, indirect methods have to be resorted to understand their aetology. Causative relationship between an agent and a disease is established through epidemiological studies, in which the incidence of disease in the exposed population is compared with that of a non-exposed population. An epidemiological study can be either retrospective or prospective. In the former, disease/deaths which have already occurred in the past are studied. In contrast, a prospective study is futuristic, the student waits for the event to occur. If a clearly identifiable trend is discernible, it is ethically sound to study the past, so that speedy remedial action can be initiated.

In this section, the incidence of cancer and mortality due to heart disease and all causes during 1970-1984 among IRE workers is examined. In an epidemiological study, the two population compared (the exposed and the control groups) should belong to similar socio-economic, age-sex groups.

Given the weakness of available estimates/data, use of a sample of industrial workers sharing a common socio-economic background would yield mroe reliable results. Adjacent to IRE, there are three more industries which form a cluster. There are the Hindustan Insecticides Limited (HIL), producing organochlorine pesticides like DDT and BHC, the Fertilisers and Chemicals Travancore Limited (FACT), manufacturing nitrogenous and phosphatic fertilisers and the Travancore Cochin Chemicals Limited (TCC) producing caustic soda, chlorine, etc. HIL and FACT have carcinogens in the work-places, like BHC and DDT in the former and rock phosphate which contains uranium in the latter.[5] None of the chemicals handled in TCC is known to be cancer causing. Moreover, since both IRE and TCC went on stream during the same year, the age composition of workers is more or less similar.

In TCC, caustic soda is produced by electrolysing sodium chloride (common slat) using mercury as cathode. Mercury is highly toxic; chronic exposure can cause neurological and skeletal disorders. Workers are also exposed to heavy concentration of chlorine which is a by-product. Over and above the pollutants released by their respective industries, the workers of both IRE and TCC have to live with invading pollutants from neighbouring factories—sulphur dioxide, ammonia and fertiliser dust from FACT and DDT from HIL.

In terms of wages and perks, both the population groups are on a more or less equal footing—the only difference being a higher rate of bonus and a liberal housing loan in IRE. On the health care front, workers receiving less than Rs 1,000 a month are insured under ESIC. Those earning above Rs 1,000 have a company medical scheme under which expenses incurred on treatment of workers and their families in private hospitals recognised by the management are reimbursed.

TCC has a residential colony in Udyogamandal itself, which is high pollution zone.[6] In contrast, workers of IRE have their residence scattered in the entire district. Hence, the pollution load in the living environment (beyond the factory) of TCC workers is higher than that of IRE.

In this study, we have used the workers of TCC as well as those insured under the ESIC as our control populations.

In the case of cancer, there is a time lag between the crucial exposure to carcinogen and the manifestation of the disease. Known as the latency period, this ranges from six to 30 years. In this study, we are examining cancer cases between 1970 and 1984. While the exact time of the crucial exposure cannot be known, we can be reasonably sure that the first worker diagnosed as a cancer patient in 1970 must have had his exposure at least six years before, i e, in 1964. As such, we would have to consider the worker strength of 1964 as the base line population.

In an industry, exposure to pollutants is not uniform among all categories of workers. An estimated 20 per cent of employees who are on non-production jobs (like clerks, peons) can be classified as the marginally exposed group. The remaining 80 per cent of employees, whom we classify as the seriously exposed group are taken as the base-line exposed population.

These manipulations are not possible in the case of ESIC data because we have no way to ascertain the year of enrolment or the nature of the job of the workers who have been diagnosed as cancer. As such, we would take the entire insured workers of the respective years as the base-line population.

Since ours is a retrospective study, we are examining the mortality profile of the past 15 years. Here, we are confronted with the problem of assessing the exact cause of death. What are the sources of information from which we can obtain reliable data? Firstly, the hospitals. While some hospitals informed us that the old documents are not preserved, two major hospitals refused to co-operate for reasons known only to themselves.[7] Then we looked into the register of births and deaths maintained by the local self-governments. In many cases the cause of death has not been recorded properly. This is an all-India phenomenon. It is only recently that the Indian Council of Medical Research (ICMR) has initiated a programme for maintaining the mortality data in India according to the World Health Organisation (WHO) norms.[8] Another source could be the personal dossiers of workers maintained by the management. Even this source is not free of errors as can be seen in the ensuing discussion.

Insted of depending on a single source, various soruces as given below have been consulted so as to arrive at a near accurate conclusion. Lists of workers who died along with the cause of death were obtained from the trade unions of IRE and TCC. The cause of death was cross-checked from dossiers. Cases in which the union data did not tally with the dossier, detailed interviews of co-workers, trade unions activists, family members and neighbours were conducted.[9]

To enable comparison of the data of all the three population groups (IRE, TCC and ESIC), it has been converted into rate per 10,000. After conversion, the relative risk in IRE was estimated.[10] Statistical test (chi square) was used to see if the difference between the study and control populations is significant.

Cancer

According to the unions, 14 workers of IRE and four workers of TCC died of cancer between 1970 and 1984. As per the IRE dossiers, only eight workers died of cancer.

Out of the six controversial cases, it is impossible to accept the unions' claim of cancer as cause of death in the first three cases. In the case of one, it is difficult to arrive at a definite conclusion. The last two workers, we are reasonably sure, died of stomach cancer. This brings the total number of cancer deaths in IRE to ten. One worker is now under treatment for lung cancer. In all, there have been 11 cancer cases in IRE since 1970.

Our data have the following serious limitations:

(a) Workers who left service since 1964 have not been followed up. Table 2 provides the service particulars of the existing workforce in IRE. Out of 471 employees, 67 started working before 1960 and another 30 joined between 1961-66. Average annual enrolment during 1961-66 being 5, there were 87 employees on April 20, 1985, who belong to the pre-1964 stock. Thirty-two workers of the pre-1964 stock are now in the managerial cadre, another 22 died while in service during 1970-1984. In other words, out of 328 base-year worker population of IRE, 187 have either resigned or retired. Of these, 140 (80 per cent) belong to the seriously exposed populaton. Since we do not know what happened to them, our result is likely to be a gross underestimation of the exact risk in IRE.

(b) The level of accuracy with which cause of death is recorded in the dossier is questionable. For instance, in one case, of death has been mentioned as "failure of heart." which is a layman's term for cardiac arrest. More revealing is the entry showing costochondritis as cause of death.

In IRE, there were four cases of stomach cancer. The remaining cases are of different sites. While radiation injury can produce malignacy of any organ, there is a strong association between certain types of cancer and occupational exposure, like lung cancer among uranium dial painters. Let us see if we can offer any explanatory hypothesis for the randomness of 'site of cancer' in IRE.

IRE has all kinds of radiation hazards, *viz*, external from beta and gamma rays, internal from ingested nuclides and inhaled radioactive gases like thoron and radon. The most serious threat in IRE seems to be from the internal emitters which are either ingested or inhaled. Now let us see the behaviour of internally deposited radioactive elements:

(a) Thoron is a noble gas (it does not react at all). It has alpha activity and a half life of 54.5 seconds. Polonium, the thoron daughter is a slid with alpha activity and a half life of 0.16 seconds. Next in the series is Thorium B with beta and alpha activities and a half life of 10.6 hours. While thoron does not react, her daughters get attached to the tissues nearby, in this case lungs. And keep on damaging the cells.

(b) We have earlier observed that all heavy metals (including the radioactive ones) follows the course of calcium. In other words, as the ageing process sets in, ingested radioactive metals settle down at soft tissues all over the body.

(c) The ITRC study quoted above reveals that thorium also settles down in testicles. Albert R E reports that workers in plants refining thorium have shown chronic deposition of the metal in lungs, lever, kidneys, spleen and bones.[11]

All this evidence proves tht once thorium enters the body, it behaves very randomly. So does tumour. Clumps of cancerous cells, often break away from the parent tumour, migrates to new organs seed out and start growing as secondary cancers, which are known as metastases (literally, "standing in an abnormal place"). Sometimes, the primary cancers remain undetected. We have therefore taken all types of cancer (including leukemia) into a single group for the purpose of analysis.

Heart Diseases

Let us now examine the incidence of heart diseases in IRE and TCC. The method of data collection for this has been the same as that for cancer.

A word of caution—as mentioned earlier, workers of both the factories are exposed to invading pollutants from neighbouring factories. Among such pollutants, sulphur dioxide released by FACT is of more significance in terms of concentration as well as the associated health hazards. Chronic exposure to this gas leads to thickening of alveoli walls of lungs, causing respiratory diseases like bronchitis, which at a later stage can graduate to heart diseases. This disease cycle is kwnon as Chronic Obstructive Pulmonary Diseases (COPD). The incidence of respiratory and heart diseases is very high in the entire area.

All the cases of heart diseases in IRE therefore cannot be attributed to the pollution caused by the manufacturing process in the plant. Likewise, the frequency observed in TCC may not be the expected frequency in an average factory. Assuming that the pollution load by FACT is equal in both IRE and TCC, the difference in frequency between the two population groups can be attributed to the presence or absence of causative agents in their respective work environments.

The figures for IRE and TCC are fatal heart diseases. The ESIC data, which also is presented below represents the incidence only—not all of them might be fatal.

Mortality Profile

So far, we have examined the frequency of two radiation caused diseases—cancer and heart diseases. There is another group of diseases which is broadly classified as radiation-aided. We saw that radiation can also cause cell death. An absorbed bone marrow dose destroys white blood cells, which are essential for fighting infection. If cell death is massive, the organism would be rendred incapable of fighting even a very common infection.

Cell death can also lead to premature ageing. Measurement of the ageing process involves high technology gadgets which we have not been able to use. However, since the end result of ageining is death, consideration of the total mortality profile might reveal certain basic trends. Let us compare the total mortality (due to all causes other than suicide and accident) in IRE and TCC. (Mortality data pertaining to workers insured under ESIC is not available.)

In order to facilitate comparison between units, data presented earlier has been converted into rates per 10,000. Relative risk between IRE and TCC for cancer and heart diseases is 4.62 and 2.24 respectively. Coming to total mortality, IRE workers had 2.72 times greater risk of dying of all causes. More pronounced is the relative risk between IRE and ESIC which is 6.77 and 2.72 for cancer and heart diseases respectively.

How significant are these differences? In the case of cancer, difference between IRE and TCC/ESIC is statistically significant at 0.01 level. For heart diseases, while the difference between IRE and TCC is significant at 0.2 level, the difference between IRE and ESIC is significant at 0.01 level. Difference in mortlity due to all causes between IRE and TCC is significant at 0.01 level. In short, we can conveniently reject the null hypothesis.

Genetic Disordes and Infertility

During the course of the study, we also stumbled upon a few cases of sterility among workers and genetic disorders among their offsprings. The data is not comprehensive. Major reasons for limitation in data ae as follows:

(a) Most diseases of autosomal dominant variety manifest themselves at a later age. The parents do not perceive such cases as genetic.

(b) A welfare measure in IRE has not made any survey (with limited resources) of families virtually impossible. IRE is one of the few industries in India which has a unique housing scheme. An employee can build a house with a liberal loan from the company at a place of his choice. Since every worker with a minimum of ten years of service can own a house under this scheme, the unions did not press for a housing colony. Some workers in IRE feel that the liberal scheme was introduced for concealing the increased incidence of genetic disorders among the employees' offsprings. Incidentally, the scheme was introduced a couple of years after the health physicists' team took position in IRE.

Among the affected workers, one in three alone presented the children before a medical board, consisting of three doctors of Lissie Hospital, Ernakulam. The board ruled that the cases can be attributed to inbreeding.

There are two types of inheritance of genetic disorders—autosomal dominant and autosomal recessive. In autosomal dominant inheritance, only one of the parents supply a defective gene, while in the recessive inheritance, both the parents supply the defective gene at the same genetic locus. The 'book' has the following to say on the nature of inheritance:

> In as much as recessive diseases require the inheritane of a mutation at the same genetic locus from each parent, when the genes are rare, the likelihood of any two parents being the carriers for the same defect becomes small. However, if the parents have a common ancestor, and if that ancestor was a carrier of the recessive gene, then the likelihood that two of the descendants have inherited the gene becomes relatively great.[12]

A person who has inherited a defective gene which lies dormant would not be affected by the disease. He or she is called a carrier. When two carriers of the defective gene at the same locus mate, the statistical probability of inheritance is:

> twenty-five per cent of the children will be normal, 50 per cent would be heterozygous carriers and 25 per cent would be homozygous and affected with the disease . . . Since with recessive inheritance, only one of the four children in a sibship is expected to be affected, multiple cases in a family might not occur.[13]

In the case another worker, all the four children have been affected. Moreover, according to the worker, he and his wife are sixth in a chain of consanguinity. This introduces an increased possibility of some other relatives also being affected. No one has been, so far. Secondly, as the provisional diagnosis shows, all the children do not share the same symptom complex or clinical history. This suggests the possibility of damages at different genetic loci. Hence, the probability of both the husband and wife carrying several damaged genes seems to be extremely remote.

Infertility

It is not possible to assess at this stage whether all these cases are radiation-related. If they are, then the situation in IRE would have historical significance. IRE, in that case would be the first reported nuclear facility in the world to cause radiation-induced sterility among workers.

Cases of sterility deserve a closer examination. In the survey of literature, we saw that unlike cancer and genetic disorders, sterility is a non-stochastic effect which has a safe threshold. Since there is no history of radiation-induced sterility among males, the exact sterilising dose is not known. Sterilising dose for females is 700 rems, administered during a short span of time. Since overies are more protected than testicles, male sterilising dose should be lesser than that of females. One estimate places the dose at 60 rems. Assuming that the workers became sterile during the first twelve years of their service, the annual average exposure works out to 50 rems, which incidentally is ten times higher than the maximum permissible limit.

Health and Safety Apparatus

HPD of BARC is responsible for monitoring the health of workers in all DAE undertakings. Health physicists were posted in IRE, Alwaye, in 1962, ten years after the factory went into stream. In 1966, the team recommended a few safety steps, like rotating workers from spot to spot after a fixed interval, provision of gumboots and rubber gloves, etc. HPD is supposed to monitor the dose absorbed by workers and take remedial action in critical cases. Monitoring is done by analysing the film badges worn by workers. Film badge analysis alone is not adequate in an industry like IRE where the major hazard comes from radionuclides and radioactive gases like redon and thoron. A near accurate account of the dose absorbed can only be made through analysis of biological samples which is not being done in IRE. Even the results of film badge analysis is not communicated to the workers. Similarly, HPD had conducted a chromosome analysis of Alwaye workers during the late seventies, the result of which has also not been communicated so far.

In the past, three workers were transferred to less hazardous jobs because of adverse medical findings. In these cases, the workers who had got medical advice from private practioners had to fight their way out for transfer. HPD, rather than assisting in such cases, strongly opposed the transfers. Even though all workers suffering from occupational diseses are entitled for compensation under the Workmen's Compensation Act 1923, no one in IRE has got it so far. In short, there is nothing much to comment on the health and safety apparatus in IRE.

Chromosome aberration, chemical change of DNA and cell death are the immediate cellular responses to an absorbed dose of radiation. The end result could be any of the stochastic or non-stochastic diseases mentioned earlier. In this paper, we have been able to demonstrate statistically significant differences in incidence of cancer and mortality due to heart diseases and all causes between IRE workers and control populations. The incidence of sterility among workers and genetic disorders among their off-springs reported above is seemingly higher than their spontaneous occurrence in general population.

A retrospective epidemiological study of this nature, can only formulate clinical hypothesis. At best, one can state that the study population was exposed to the agent under consideration during the reference period—in this case till 1964. Incidentally, two years after this, the so-called control measures were introduced in IRE an HPD. How effective are these measures? To obtain an answer through an epidemiological study, one would have to wait a few more years. Fortunately, we have a little more concrete evidence. In 1978, BARC conducted a chromosome study of IRE, Alwaye, workers. Though the results of this sutdy are yet to be published, there is a reference to this one of the DAE annual reports:

> In continuationof the efforts to evaluate the biological effects of high background radiation on human population residing in the monazite belt (Chavara, Neendakara in Quilon district, Kerala), chromosome analysis was carried out on 179 samples.
>
> Under our chromosome analysis programme, broad sample in the normal background areas were analysed. Data on newborn and their mothers did not indicate any differences in the chromosome aberration frequency between samples from normal background radiation areas and those from high background radiation areas.
>
> In the samples taken from the IRE workers at Alwaye, a high abberration frequency was indicated than that observed in the high background radiation, Chavara and Manavalankurichi samples.[14]

In short, workers' health was, and still is in jeopardy.

During the course of our study, we also found that there are gross irregularities in the fields of radioactive waste management, as well as storage and transportation of radioactive materials—issues which are beyond the scope of this paper and hence being reported separately.

The situation is alarming. This calls for immediate action. The management of IRE has agreed to palliative measures like scanning of all workers for tumour by the Cancer Detection Centre, Cochin, which is not enough in a hot spot like IRE. The need of the hour is a comprehensive, interdisciplinary study of the plant and the workers. In order to take effective remedial action, there should be a health survey of the workers which should include analysis of urine, blood, chromosome and tissues of critical organs like gonads. The workers who have absorbed dose above the permissible levels should be removed to safety. In the case of work environment, activity status of each spot would have to be measured and engineering measures adopted.

Such a study should have representation from the workers as well as the people because what at stake is not only the health of over 500 employees, but also the national gene pool which the present decision-makers have no right to tamper with. We do not own the gene pool.

A clear understanding of the exact magnitude of hazards posed by IRE assumes national importance at this juncture of our history. IRE is the only DAE venture which has completed 30 years of operation, which incidentally is the average latency for cancer. Today, DAE is pushing forward its ambitious plan which involves a tenfold expansionof nuclear electricity generation by 2000 AD. Before allocating a massive Rs 22,177 crore from the public exchequer for the planned expansion, people have a legitimate right to look into the track record of DAE during the past three decades of its existence.

[This report is part of a book which is now at the design stage. This study is a joint venture by the trade union activists of IRE and TCC, Forum for Occupational Health and Environmental Studies, Alwaye, E P Mohanan and a group of students of Medical College, Calicut, and Krishnamohan, a scholar of environmental science at Jawaharlal Nehru University (JNU), New Delhi. The team acknowledge guidance and help by Gyanesh Khudaisya, D Banerji and Imrana Quadeer of JNU. Fraternal assistance from Nikolai Izmerow, Director, Institute of Industrial Hygiene and Occupational Diseases of the Academy of Medical Sciences of the USSR, Moscow, Ralph Nader and Joan Claybrook of the Critical Mass Nergy Project, Washington, and Anthony Mazzocchi, Director of Health and Safety, Oil, Chemical and Atomic Workers International Union is gratefully acknowledged.]

Notes

1 **R V R Krishna Iyer, (1985): 'Nuclear Nationalism and the Law'**, *Philosophy and Social Action*, Vol XI, No 2, pp 9-19.
2 For the first time in the history, DAE released the annual average radiation exposure to workers of Tarapur Atomic Power Station (TAPS) on May 10, 1983 (See *Times of India*, Bombay, May 11, 1983). This release was in response to a detailed report by Praful Bidwai in *Times of India* dated May 9, 1983.
3 ILO (1983): *Encyclopaedia of Occupational Health and Safety*, Vol II, p 1882.
4 Ibid, p 1883.
5 ILO, (1983) ibid, Vol.II, p 1679.
6 Concentration of sulphur dioxide and particulates in the area, measured by the National Environmental Engineering Research Institute (NEERI) is given in Table A.
7 Lissy Hospital and Medical Trust Hospital, Cochin are the Major hospitals which refused to co-operate without assigning any reason.
8 Gandharan P, ibid.
9 E P Mohanan a tutor in Trichur Medical College was present in many of these interviews. Statements involving medical judgments are his.
10 "Relative risk is the ratio between the incidence among exposed and incidence among non-exposed". See J E Park and K Park (1981), *Text-book of Preventive and Social Medicine*", Jabalpur, pp 279-280.
11 Albert, R E (1966): *'Thorium: Its Industrial Hygiene Aspects'*, Academic Press, New York/London, pp 58-64, quoted in Tandon, S K *et al*, (1977): 'Effects of Monazite on Body Organs of Rats'-*Environmental Research*, Vol 13, pp 347-357.
12 Robert G Petersdorf, *et al*, (ed) (1983): *Harison's Principles of Internal Medicine* 10th edition, McGraw-Hill, p 319.
13 Ibid, p 318.
14 Government of India, Department of Atomic Energy (DAE) Annual Report 1978-79, p 38.

[*EPW*, March 8-15, 1985 in which the original article appeared is out of print. Copies of the article are available at Rs 10/- copy from: *The Circulation Manager, EPW, 284, Skylark, Shahid Bhagat Singh Road, Bombay 400 038.*]

UPDATE

News and Notes

Bombay's Health Priorities

A LONG-STANDING criticism of health services, curative and preventive, private and public, has been that they are heavily urban-oriented and are skewed to offer the least assistance to those who need it most, the rural poor. What is often not as well documented is that the distorted priorities also influence urban health care. The annual budget estimates of the Bombay Municipal Corporation (BMC) recently presented provide a glimpse of just how efficiently the civic body is discharging its obligations of providing health care.

The corporation spends 29 per cent of its revenue budget on public health and medical services. Expenditure on health care has been steadily increasing—there has been a 69 per cent increase in the last three years. What is important, however, is that most of this increasing expenditure has been on the curative side. The health budget comprises three components—public health, medical relief and education, and measures to control environmental pollution. The proportion spent on public health has consistently, even if marginally, decreased—from nearly 15 per cent in 1977-78 to 13.7 per cent. A grave result of this is that neither the infant mortality rate nor the overall death rate has shown an improvement in ten years. Pollution control which includes such activities as air quality monitoring, research laboratories for analysis of pollution as well as an enforcement wing for ensuring the implementation of control measures, accounts for less than one per cent of the expenditure. Admittedly, the allocations in this area have increased many times in ten years, but considering that the BMC's own health survey has shown a definite link between the prevalence of a large number of health problems and air pollution, should this area not have been considered a priority area in health?

The corporation appears to be attacking the problem of health from the wrong end—waiting for people to fall ill so that they may be taken care of, instead of eliminating the root causes of ill health. The corporation is not alone in its apparently muddled understanding of these issues—every government, state and central, has followed the same principles of neglecting preventive health care. The reasons are, of course, obvious. The creation of imposing hospitals equipped with new equipment (even if they are ever put to use) adds to the prestige of the authority even as it offers temporary 'repair facilities' for the masses. However, expanding public health measures is quite another matter. In doing so, the state will necessarily have to confront the very classes which sustain it—whether it is a matter of properly distributing clean water supplies or bringing defaulting industries to book.

Even within curative health care, the services are so created as to provide the least access to the working masses. Hospital beds, for instance, show such a skewed distribution. In 1980, 60 per cent of the hospital beds maintained by the corporation were in city wards in south Bombay comprising 35 per cent of the largely better-off population; the civic body did not maintain a single bed in the area which 'houses' a large proportion of the working class population of the city. To make matters worse 67 per cent of the government beds are also in these south Bombay wards. The rest of the population (the lower middle class and working class) is forced in the city to depend on private medicare. Although the number of hospital beds has gone up since then, the situation is hardly better. As the municipal commissioner has pointed out, "we have undertaken the construction of many skyscrapers for increasing the number of beds in our major hospitals . . . while a large suburban population is denied immediate access to primary health centres".

Quite obviously, whatever the increases in the health budget, it is unlikely to benefit the urban masses. In fact, what with the commissioner's proposal to hike hospital registration charges, "restricting use of costly medical equipment" by introducing "reasonable charges" for their use and "avoiding waste of medicines and diet", users of municipal facilities will find the services gradually moving beyond their reach.

PP

Ruins of War

LEBANON is constantly reported for internecine fights, the shifting loyalties of the groups involved in the fights and above all Israel's repeated invasion of that country, the latest being in 1982. In the din of all this gunfire and among the ruins of war, the condition of millions of Palestinian refugees in Lebanon and in Israeli occupied territories of West Bank and Gaza has almost been forgotten. War itself has become an epidemic in the region and its impact on people's health is of epidemic proportion.

The fighting between the Palestinians and other armed groups which are from time to time supported by Syria, Israel or Iran, has almost destroyed the whole social fabric, and as a consequence even the health care services, in the Palestinian refugee camps. Even the abysmal health services which were available to them before the 1982 Israeli invasion of that country have almost ceased to be. For the last two years the Syrian-backed Amal Shite Muslim militia has resorted to intermittent seizure of Palestinian refugee camps and thereby cutting the residents of all civil and medical supplies.

Chatila camp has been reduced to rubble and its population have fled south in search of food and shelter. In Bourj-al-Barajneh camp 35,000 people along with the British charity, Medical Aid for Palestinians are trapped. The electricity and water supplies to the camp are cut-off by the Amal militia. Food supply is not reaching the camp people. Anybody coming out in the street to get water and food or trying to leave the camp is shot dead. All relief supplies are turned back by the militia. Much of the medical facilities established by the MAP at the cost of £ 30,000, after destruction in the 1982 war, in the Gaza hospital, are destroyed including the hospital building itself. Another remaining hospital, the Haifa hospital, has lost two of it's there floors and there even medical worker's and patients have been hit by sharpnel. Because of such attacks on all these camps, it is estimated that almost 2000 camp inhabitants are killed, 4500 wounded and 80,000 made homeless.

A C J from
The Lancet, February 21, 1987.

Double Standards: Some Improvements

In the past dozen years, major pharmaceutical firms have made substantial improvements in the way they label and promote their products in the Third World. They are now less likely to puff up their claims to physicians and are more willing to disclose possible serious or lethal adverse reactions.

These are the findings of three researchers at the University of California School of Medicine in San Francisco (UCSF)—Milton Silverman, Philip R Lee and Mia Lydecker. This group pioneered comparative marketing studies beginning in Latin America in the early 1970s. Their latest findings were published in the October 1986 issde of the International Journal of Health Services.

Their original survey covered 147 products marketed in the United States, Mexico, Central America and South America and the results were published in 1974. In their second study, published in 1982, the UCSF group covered 515 products marketed in the United States. Latin America, Central Africa and Southern and South East Asia. Their present investigation includes 1,069 products marketed by about 300 companies in the United States, the United Kingdom and 28 developing nations.

The present study reports striking changes. Many of the firms were 'found to be showing more restraint in limiting their claims int he Third World to those which can be supported by scientific evidence and were far more willing to desclose serious hazards'.

In the case of dipyrone, a widely-used but reputedly dangerous remedy for fever and pain, itw as noted that 119 of 155 products now carry warnings of possible fatal blood damage. This represents a marked improvement over the situation in 1974 and in 1982. Most of the products still without such warnings were found to be marketed in India, Mexico and Central America, mainly by American and West German firms.

Of the 12 aminopyrine products, used for the treatment of fever and pain, seven—marketed by Polish, Spanish, Swiss and German firms—carried no adequate warnings of possible blood damage. Of the 15 phenacetin products which are used to control fever and pain, eight carried no warnings of possible kidney damage. They are marketed by American and German companies. All three of these products have long since been banned from the United States and the United Kingdom.

In the case of chloramphenicol, a valuable but potentially dangerous antibiotic used especially in the treatment of typhoid fever, 93 of 103 products now list warnings against use in trivial infections, against preventive use and against prolonged use. This too represents a remarkably improved situation. Nevertheless, some firms were found to be promoting chloramphenicol products in Indonesia, the Philippines and Thailand for such a minor illness as tonsilitis.

Similar improvement was noted in the promotion of tetracycline and other antibiotics, tranquilizers, anti-depressive agents and anti-arthritis drugs.

Silverman, Lee and Lydecker also examined the promotion of numerous 'sex-tonics' in the Third World by various American, European and Third World compaies. These are widely recommended and sold for such indications as premature aging, sexual weakness, lack of physical and mental capacity, failing memory, fatigue and 'general wearing-out phenomena'. Evidence to support such use is questionable at best. None of the products is allowed on the market in the United States or Great Britain.

Drug companies cannot explain away these differences merely by claiming that the laws of a specific developing nation dictate what may or may not be put on the label. In the same country it was obvious that some brands of a particular drug carry detailed warnings, while other brands of the identical drug carry no warnings of any kind. Among the companies whose products were examined, some were based in capitalist nations, some in Marxist-Socialist countries and some in the Communist bloc. 'Our data show no significant differences between them inthe reliability of their promotion', the USCF team said. Among the profit-making companies, some were multinational while others were domestic or national. 'Our data indicate that most cases of irrational promotion involve domestic firms in the Third World'.

from *HAI News*, February, 1987.

Community Participation in Integrated Child Development Programmes

The Kerala Experience

v raman kutty

This paper, attempts to enumerate the obstacles that stand in the way of community participation in Child Development Programmes, drawn from the experience of Kerala state in India. There is also an attempt to provide a conceptual and theoretical basis to the need for community participation in health programmes.

IN this article I shall attempt to discuss some of the issues related to community mobilisation for action in child development programmes. The first part of the paper shall delineate the conceptual or theoretical basis for the need for community participation in child development programmes; the second part shall be devoted to examining some of the experiences in the light of these.

The first major task in such an attempt is to define the nature of child development programmes. Child development programmes grew out of two ideas:

1. The realisation that the development process has to be seen not just in its economic perspective.

Rajni Kothari says: "I suggest that the unidimensional and almost exclusively economic basis of the development paradigm has undermined the prospects for not just development, but for the sheer survival of large strata of the world's people. Mere transfer of resources and technology does not necessarily bring us any closer to the realisation of a desired state". (Kothari, 1985).

Among these 'extra economic' goals of development, child survival should certainly demand high priority. "High rates of infant and child mortality are one of the heavier burdens borne by the populations of the less developed world". (Barnum and Barlow, 1984). Hence even from an economic point of view, investment in child services—for health, literacy, and in general better quality of life for children—have returns in terms of quality of personal in later years that justifiy the investment.

2. The second idea—closely related to the first—is that of an integrated package of services for children. Most of the services offered have nothing now in their content: be it immunisation, supplementary feeding, promotion of breast feeding, or informal education. What is new is the integrated approach in supplying these services. But it should be realised that "...true integration must mean something other than the simplistic invitation of everybody professionally concerned with a problem, to do what they are used to doing in their sector specialities, with the only difference that they do it simultaneously". (Kunttson, 1985). Thus integration itself is to be seen as a strategic move, a specific input into the defence against deprivation.

The Child Survival and Development Revolution (CSDR) as envisaged by the UNICEF could be described as the fomalisation of all these ideas. The CSDR is—or should be—the ultimate goal of the integrated child development services initiated by many of the developing countries including India. But it should be understood that it is difficult to separate the process and the goal in this: the CSDR is both the objective of the programmes as well as their organisational content. The CSDR be said to be characterised by three principles in its organisation, each of which underscores the importance of community participation for its success:

(1) The 'demand based approach' to child health

(2) Low cost interventions that can be afforded by the poorest of communities; and

(3) Approaches with minimum technological complexity, so as to encourage self reliance. I shall examine each of these in detail.

The Demand Approach to Child Health

The central idea behind the concept of the CSDR is to enable parents to protect their children from preventable death and disablement: and the thrust of the strategy is to convert 'latent demand into effective demand' for child health. (Vittachi, 1984). What is the concept of demand for health? For economists, the demand is the "ability and willingness to pay". (Fuchs, 1968). Paying may not be always in terms of money. In an under-developed community, even when services are supposedly free, mothers have to forego one day's work to avail of these services, because of so many reasons that I need not go into. The value these sometimes illiterate and mostly formally unemployed women place on their time, is the cost of the service. In terms of relative value to the family earnings, this should be certainly a high value. The demand approach to child services in underdeveloped communities should mean, if successful, that mothers, who are the key figures in caruing for the children, are prepared to incur this cost in order to avail this service. Thus we see successful demand oriented programmes have a built in element of community participation.

But it is often not realised that what is demanded is not what is needed. The health or development needs of a community are those defined by the expert as those required for them to reach a certain predetermined level of development. In an ideal situation, health demands coincide with health needs. But more often, health 'demands' are in excess of or totally different from, health needs. There are two types of problems arising out of demand: demand failure and inappropriate demand. Demand failure in the context of child survival strategies means that mothers do not come forward to seek the protection of available services like immunisation, oral rehydration, growth monitoring, and even curative services. This problem is common in developing communities, and is in turn due to two reasons: the illiteracy and ignorance of mothers and their lack of self confidence in decision making roles about children, which are themselves related problems. The second demand problem, that of inappropriate demand, is more common in developing communities like Kerala, where under the influence of high pressure advertising, educated but poor mothers reject cheap but effective alternatives and go in for child health inputs like milk foods, weaning foods, and tonics which they can ill afford. Both these problems, insufficient demand as well as inappropriate demand, exclude community participation in child development programmes: the first because people do not come forward to take part in the programme, and the second because they seek solutions elsehwere.

Low Cost Intervention

The second point of stress in the CSDR, and also important in ensuring community participation, is that the interventions suggested are less costly, which can be afforded even by the poorest community. In fact, "voluntareeism or community contributions are a necessary element in the cost structure if the programme is to be maintained on a national scale". (Nyix, 1984). We should define what we mean by 'cost'. What is apparently 'low cost' in terms of rupees and paise may be high cost in terms of time spent to a rural mother in a developing community. Here again, it is important to understand that in such a situation, community participation is one thing that can make costs less.

Inputs of Low Technology Complexity

The third point of emphasis is that the suggested interventions have very little technical 'density', in the sense of needing trained personnel and sophisticated equipment, in spite of being the fruit of modern thought. In fact, among the four key strategies currently emphasised in the CSDR—growth monitoring, oral rehydration, breast feeding and immunisation—the only intervention with any technological sophistication is immunisation. The central idea is that instead of becoming complex tools in the hands of experts in respective fields, these techniques become effective weapons in the hands of the community to combat threats to betterment of children's conditions. Thus theoretically, this should also have a strong component of community participation.

There are two reasons why I have gone into some detail to show how the child survival and development revolution is built around concepts which essentially entail community participation, by their very nature. The first is to build a conceptual background against which I shall examine some experiences with child development programmes. The second and the more important reason, is to make the point that while the three aspects discussed: demand orientation, low cost, and limited technology, are necessary conditions for community participation, they are not sufficient. If community mobilisation is to be truly effective, there should be a really participatory role for the beneficiaries at every stage from planning to implementation. I shall come back to this point in the last part of this paper.

In this part there shall be an attempt at examining some of the bottlenecks to community participation from experience of child development programmes in Kerala. We have witnessed a series of programmes operating at various stages, fulfilling different needs in child survival and development norms. The two programmes which shall be discussed here are the (i) the Composite Programme for Women and Preschoolers, which was in operation through balwadis (children's centres) in Kerala. Here the development department of the government of Kerala in conjunction with the health department, provided an integrated package of services to preschoolers and pregnant and lactating mothers. (Government of Kerala); (ii) The Integrated Child Development Services Scheme of the government of India. It was launched in 33 community development blocks all over India in 1975, and consequently grew to 300 blocks by 1981. In 1982 the ICDS was included as the principle vehicle for meeting the needs of children and their mothers under the twenty point programme of the prime minister. (Sadka, 1984).

Demand need variation: One of the most important flaws cramping the execution of such programmes is the design which is decided centrally and is usually inflexible. It is not often remembered that child survival goals, and hence demand as well as need differ widely in India, among states as varied as Kerala with its low infant and toddler mortality to that of Uttar Pradesh, which would approximate to the all India picture in these indices. Unfortunately this factor is not given due consideration in the programme, and the goals and style of functioning are decided without taking into account the regional differences in child survival and development priorities. As a result, aspects of the programme which are very relevant to some areas are totally irrelevant in others, and consequently cannot attract people's participation. This is a price we have to pay for inflexibility. Kerala being a state where the demand for formal education is very high, the age of school entry is five years, and pre-primary education is very much in vogue, it is not surprising to find many rural areas where even poor mothers are reluctant to send their children to the ICDS after four years. But in a state with a poor level of formal schooling, the non-formal education imparted in the ICDS centre till six years may be an important input which cannot be ignored.

Rigid structure: The second and very important aspect which precludes community participation is the rigid nature of the programme implementation. The beneficiaries have no role in deciding the site, or number of functionaries at the local level. Here it is interesting to contrast with the CPWP programme which is now being eclipsed by the ICDS. The design of the CPWP was such that in each area, the people had to form and register a mahilasamajom (women's club) which had to provide the building, premises and local level functionaries for supplementary feeding and other child development programmes. There was also an attempt to provide the local type of food and grow some of the vegetables in the premises, coupled with many employment generating activities for women, like goat rearing etc. This character of participation has been lost in the design of the ICDS. This is also a particular example of the point raised earlier, i e, whereas in other states of India one should not expect women to take the initiative to run their own community development programmes, and hence a government administered programme might perhaps act as a focus for initiation of such activity, the opposite is the case in Kerala. In Kerala women do have the confidence and initiative to run these programmes, perhaps borne of their better literacy and exposure to media, and as such the programmes should be sufficiently flexible to allow their participation. This would be expected of a demand-based approach, and would simultaneously ensure community participation.

Goals for beneficieries and goals for functionaries: The point is again related to the first two. When a programme becomes centrally administered with a fixed pattern and permanent staff, it is inevitable in the long run that the executives of the programmes, on the whole, put their own personal goals first. This is a folly to which it is particularly susceptible in Kerala with its large number of educated unemployed. While it should not be grudged that such programmes have provided jobs for a number of youth it should not also be forgotten that furthering their career opportunities is not the primary aim of the programme. This point has been at the back of many recent incidents in Kerala. This is an area of conflict, which, unless resolved, effectively blocks people's participation in the programme.

Not identifying priority needs: Sometimes a community may be badly in need of a service, like protected water supply, or irrigation facilities, which, while not directly linked to child health needs, can act as a rallying point from which child development services can reach the people. Unfortunately, this aspect of community development has not been given its true importance in the programme. This is another obstacle on the way to better community participation.

Emphasis on technical aspects: There is a tendency on the part of the experts concerned with planning and implementation of the programme, especially medical personnel, to see it as exclusively a technical programme. Doctors connected with the programme should be disabused of the idea that it is a medical programme. On the other hand it should be seen as a non-medical programme with health returns. From the side of beneficiaries, there is a tendency, at least in Kerala, to view the ICDS as a formal preschool education. This is to be expected in a state where mothers put such a high value on formal education even at the pre-primary level. Here again, it is an instance of demand conflicting with need, and unless people are properly appraised of the objectives of the programme, there is a danger that they shall be disillusioned and this will effectively block their participation.

Using the programme for political leverage: It is inevitable in a highly politically-conscious state like Kerala, with political fortunes see-sawing, that programmes like the ICDS are used for political advantage. If this should happen, it alienates a large section of the community and this works contrary to the spirit of community participation.

In summing up, I should point out that child development programmes indeed have a large potential for community participation in their design and execution. In our experience, a large part of this potential is fulfilled. In fact, it would not be wrong to state that the ICDS is one programme in in the state with a large element of community participation even as it stands now. I have only tried to point out areas of conflict, the resolution of which is a must if we are to go further.

Coming back to conceptual basics, community participation in child development programmes fails if community participation itself is not seen as a primary objective. Participation should not be a means to facilitate reaching other goals. On the other hand, maximising community participation should be the primary objective, subject to the constraints. If this approach is adopted, reaching the other goals will be much faster and automatic.

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(Continued from p 115)

nuclear mind-set of those who are in a position to take crucial decisions concerning nuclear war and the arms races.

While local and regional peace movements can play a vital role in promoting the *process of disarmament and sustaining its momentum, a world completely* and *permanently* safe from the fear of nuclear weapons cannot be created by movements against nuclear weapons alone. Such a world requires transcending nationalism and national elites in the name of the universal interests of human kind. In short the struggle to create a truly and permanently nuclear free world is an intrinsic part of the struggle for socialism. Without a nuclear free world there will be no socialism. Without socialism there will be no nuclear free world!

Milk Monitors

pauline jackson

Methodologies for the Study of Low-Level Radiation in the Midwest, Charles Huver *et al*, Millville, MN, Anvil Press, 1979, $ 5.

THOSE who seek an easy introduction to the dangers of low-level radiation would do better to read the pamphlet-length summary of this book, *Nuclear Waste - The Time Bomb in our Bones.* Yet this extraordinary book is undoubtedly a landmark contribution to the debate over nuclear health hazards. It is a product of detailed investigation by a team working with Land Educational Associates Foundation Inc. (LEAF), a citizens' research and resource network who publish books, newsletters, engage in lobbying and popularise research findings for anti-nuclear activists.

This book appears to be their most ambitious attempt yet to take on the state at its own game: the monitoring of low-level radiation releases and their impacts on human beings. Their work is intended as a critique of the U.S. Environmental Protection Agency, the U.S. Atomic Energy Commission and those private or public agencies who, in the opinion of the authors, downplay the hazards of low-level radiation. Their starting point, therefore, is an alternative method of monitoring the results of low-level radiation release, to combat the defects, errors, inadvertant omissions and mistakes of official monitoring.

Their approach assumes that the problems surrounding monitoring can be reduced to precise errors, definite defects, certain omissions and accidental mistakes - an assumption that is far from proven in the book. Certainly, the authors succeed in revealing an inadequacy of corporate and state monitoring. But they present the inadequacies more as a series of random and accidental oversights than as a concerted strategy by supporters of the nuclear industry to misinform the public.

Huver *et alia* are critical of monitoring methods but not of monitoring as such. They would not go so far to argue monitoring for low-level radiation (or low-level toxic chemical exposure) has become a fetish of the chemical and nuclear industry, used to lull the public into believing that a quantifiable measurement is equivalent to quantifiable control over releases (as argued by Levidow and Pomata in *RSJ 9*). On the contrary, the authors accept monitoring and seek its extension and perfection by a more sensitive, all-encompassing methodology.

To illustrate their perspective: an example cited in the study is the frequent use by nuclear proponents of the idea of 'the average dose' of low-level radiation, which gives an 'average' population a once-off hit of radiation and then allegedly disappears. The authors expand at length on the inadequacy of monitoring which fails to test for the consequences of all 189 radionucleides which can have an impact on health, with tragic consequences in cancers of specific organs of the body of individuals. The monitoring of selected radionucleides can be attributed to an inadequate methodology, or it can be conceptualised as a deliberate attempt to conceal health hazards, that is,as a political choice by state and corporate scientists to hide health risks from the population. If all 189 radionucleides were monitored and the results rendered public, this would imply that the nuclear industry and its state supporters did care about health - an assumption that proved fatal for nuclear activist and trade unionist Karen Silkwood, who was assassinated while attempting to prove the hazards generated by her own nuclear workplace.

The LEAF study provides some useful insights into milk monitoring techniques. Milk monitoring had been going on for years in Wisconsin, where the research team was based, so records of the results were available from various monitoring stations over a period of years. Examining the records, they found evidence of radioactive substances which could only have come from atomic fallout during the 1950s. Matching the peaks and drops in measurements with information in tests carried out in the atmosphere, they demonstrate the continuing impact of radiation on a population who were perhaps only children at the time of the test. They suggest a method of calculating the half-life of radioactivity still in the bones of adults who were exposed at the time, and who would be vulnerable to cancer today.

The authors were surprised to find that the records were blank for considerable spans of time. In some records, the same results from monitoring appear on consecutive readings, from which they surmised that NO monitoring of milk had been carried out during certain periods, while on others the results of the preceding tests were copied into the records. In addition, monitoring results of *no* radioactivity were to be found in the Wisconsin records. This provides the authors with an occasion to disect some arguments around 'detectable levels' of radiation. In this regard they remark: "...it is obvious that realistic dose estimate cannot be attempted by assuming that concentrations below a "detectable level" must be interpreted as meaning that absolutely NO iodine-131 is present". (pp. 61-62).

The statement reveals a weakness in their analysis of the purpose of monitoring in the first place. If the purpose of monitoring were to reveal the presence of radioactive substances in the milk, exact and precise measurements (however miniscule) would no doubt have been recorded. If the purpose of monitoring is to detect low-level radiation at and above the 'safe' threshold levels, then there is no need to record tiny amounts of radiations, since such tiny amounts are presumed by the monitoring agencies to be safe. The milk monitoring records which appear so defective in the eyes of the researchers are undoubtedly very adequate from the standpoint of the agencies doing the monitoring, since the test results conform to their intention in monitoring: to prove that radioactivity in milk is not at harmful levels... levels being the crucial word!

Not content with combing the state's radiation monitoring records for faults, the authors compare nuclear reactor manager and state interpretation of the results with their own interpretations. They note that nuclear reactor utility managers and owners managed to underestimate the results of the monitoring by half. The researchers attribute this underestimation to the use of formalin, which reduces the detectability of the radionucleide Iodine-131. Being cynical, one could also attribute the underestimation to dividng the original results by 2...

The study is extremely useful in its treatment of the food cycle and low level radiation exposure; this is perhaps the best section of the book. The authors insist on the importance of the food chain as a pathway for low-level radiation ingestion. The researchers examined the dietary patterns of the Wisconsin population, including the diet of so-called minority groups. In an implicit critique of the 'average' population perspective, they detail the differences in life-style among the Wisconsin population and the accompanying variations in eating and shopping habits. They calculate the predominance of dairy products in the eating patterns and then break down the dairy products according to whether or not they were extensively processed. They propose that those who eat processed (as opposed to fresh) dairy products were less likely to get radiation exposure, since the half-life of the radioactivity in fresh milk, for example, had had more time to decay during the processing.

If one hadn't been turned off dairy products by this stage, worse is to come in their assessment of other food products. The consumption of wild berries, foods growing in marshy areas and wild venison were extremely popular in Wisconsin. The topography of Wisconsin—with its snowfalls and extensive marshy, lichen and moss-maden lands—is apparently conducive to the establishment of radiation pathways. Animals and foods with their sources in these terrains are more likely to 'carry' radioactivity from previous fall-out than other foods. Poaching of venison is so popular as to make venison a staple diet for many Wisconsin families; the deer graze on the marshy lands close to the areas of the state with the highest concentrations of Wisconsin residents who are either vegetarian, fresh-food conscious or opposed to processed food, the authors point out the radiation hazards of diet containing berries, unmilled grains and soyabean. Not even sunflower seeds escape their scrutiny as concentrators of Strontium-90! Combining factors - of diet, age, proximity to nuclear reactors, waste facilities for reprocessing nuclear materials, age when testing was being undertaken - the authors attempt to devise a methodology for examining the radiation exposure already received by the population of Wisconsin and the amounts that are still decaying in their bones from previous exposures as the half-life of radioactive substances continues to decay over decades. Their methodology resembles that used in sociology and psychology for multi-variable factor analysis.

In the absence of a chapter presenting the authors' scientific assumptions or philosophy of science, the reader is obliged to deduce for her/himself where the authors stand on monitoring, research methods, source credibility, statistical methods and so many other fundamental issues. One can draw some conclusions from their concern to enlarge the numbers of radionucleides and radiation pathways which are submitted to monitoring and their interest in the impacts on individuals in specific geographical zones, districts with distinct living and eating patterns. Their work rejects hypothetical models of the impacts of low-level radiation on 'average' populations and attempts to reconcile multiples, types and volumes of radiation emissions with groups living in their path or liable to consume radioactive contaminated foods along their pathways. Put another way, the authors reject a robotic conceptions of human beings—robotic in the sense of each person being an exact replica of the next in history, culture, lifestyle, age and so on. Instead they are attempting to humanise monitoring methodologies, to give them relevance to local communities, such as those living in the various counties of the State of Wisconsin.

It is to the credit of LEAF that they responded quickly to popular demand by publishing in pamphlet form a most readable summary of the book: *Nuclear Waste - The Time Bomb in our Bones.* Besides this 16-page cheap version of the book, LEAF have 3 informative brochures presenting the salient aspects of selected pieces of their research, aimed at Wisconsin's commune and health-food population. These formats - pamphlets and brochures - show that LEAF is capable of citizen research which unites grassroots activists and researchers into dialogue. It is all the more surprising, therefore, that *Methodologies* does not rise to the same standard of accessibility as thier other publications.

It is all the more important to have an accessible presentation of their philosophy of science when one realises the conclusion that Huver *et alia* draw from their research. They predict that Wisconsin 14 year-olds have an increased risk of cancer from just 3 radionucleides in their food - a risk double or more than the normal cancer risk. They predict that 14 year-old Wisconsin girls have an increased risk from all cancers equivalent to 25 per cent above the normal cancer risk. The authors remind us:

> Some of the Strontium-90 that found its way into baby's milk bottle in the early 1950s is still in the cells of that individual. Every year it delivers an additional 'annual' dose. Every year it increases that individual's risk of cancer (p. 168).

The risk of cancer and the suffering it implies for individuals is all the more astounding when one considers that, by the time these 14 year-olds become middle-aged, they may never have been near a nuclear reactor, may live on another continent, may never have worked in the nuclear industry and may imagine themselves safe from exposure. LEAF is saying that the damage has already been done. Low-level radiation is inside the environment of Wisconsin and cannot go away. In the words of the authors:

> It has been 'lost on the way to the bank' - it is irretrievable - it will never be safely contained in some ultimate waste storage repository. It will inevitably affect the health of individuals in the Wisconsin case study and others yet unborn (p. 179).

For authors of *Methodologies* there is no 'return to normality' after a reactor closes down or after testing halts. Low-level radiation still continues its assault on the cells of individual humans. For this protracted notion of war against radiation hazards, this book's contribution to the literature on low-level radiation is a welcome addition. For those who seek a critical analysis of monitoring as a tool for politically cooling-out agitated residents and citizens, this is not the text to peruse. But it could serve as a useful reference source for the wider debate about disinformation techniques employed by the nuclear industry and its supporters.

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Hunger and Myth of Plenty

bernard d'mello

Empty Stomachs and Packed Godowns: Aspects of the Food System in India by Bharat Dogra; published by Bharat Dogra, D-7 Raksha Kunj, Paschim Vihar, New Delhi 110 063; 1987, pp VIII + 126, Rs 50.

THE stock of foodgrains in India has increased from 11.7 million tonnes in 1980 to 29.2 million tonnes in 1985. However, this huge stock of foodgrains is not an indication of plenty. Rather, it is one of the symptoms of lack of purchasing power of the poverty stricken millions who suffer from hunger and malnutrition. Bharat Dogra, a free lance journalist, presents a radical outline of the food problem in India.

More than 70 per cent of rural households lack the means to avail of even the least-cost balanced diet as recommended by the Indian Council of Medical Research (ICMR), which is the bare minimum ration. According to the author, the landless labourers and peasants operating upto one hectare of land, who constitute 47 per cent of the rural agricultural population, experience hunger and malnutrition in the most acute form. In several villages where land is infertile and in highly drought-prone areas, peasants operating more than one hectare of land also suffer from acute hunger and malnutrition. The single most important cause of hunger and malnutrition is inequality which deprives a majority of the population of access to resources which can be employed to produce food or yield an income for purchasing food.

Is India self-reliant in food? Self-reliance in food is defined as the ability to produce adequate quantities of all the food items which are part of the diet of our people and are an important source of nutrition for them. The ICMR has worked out the per capita requirements of basic foods for different age groups doing different types of work. This is multiplied by the total number of people in these age groups doing different types of work and summed up to get the requirements of basic foods at the national level in India.

Domestic production falls short of requirements in cereals, pulses, milk and oils and fats. Large quantities of edible oils, and dairy products are imported. Besides large quantities of inputs used in the production of food like fertilisers and pesticides are imported. Thus India is not self-reliant in food which is contrary to what is being claimed in official quarters.

On the other hand, agribusiness promotes a massive wastage of food. In its ruthless search for profits, it ignores and hinders the basic task of making nutritious food available to a majority of the people. For instance, the loss of nutritious ingredients in the course of milling of rice and hydrogenation of edible oils.

A few regions produce a surplus of foodgrains (e g, Punjab and Haryana) while others remain deficient (e g, Bihar, Madhya Pradesh, Orissa and West Bengal). Similarly some crops have performed reasonably well (e g, wheat) while production of some others have relatively stagnated (millets and pulses). The per capita availability of millets (jowar, bajra, ragi etc), the food of the poor, has been declining. The production of pulses (chana, urd, mung, kulthi, masur etc), the poor persons protein, has stagnated. The biggest failure of the green revolution is the failure of high yielding varieties (HYVs) of rice. HYVs have failed to give the promised and much publisised higher yields despite the application of high amounts of fertiliser and irrigation water. The main reason for this failure is the high pest and disease susceptibility of the new HYVs relative to the resistance to disease and pests of the older varieties.

There is an interesting chapter on the long term adverse environmental effects of the green revolution development strategy in Punjab. The growth of legume crops (e g, grams) in rotation with cereal crops and inter-cropping practices used to be beneficial for maintaining the fertility of the land. However, during the green revolution period, the area under pulses went down from 13.4 per cent of the total area under crops in 1966-67 to 3 per cent in 1982-83 and the area under oil seeds has gone down from 6.2 per cent of the total area under crops in 1966-67 to 2.6 per cent in 1982-83. There has been a greater reliance on chemical fertilisers for maintaining the fertility of the soil relative to the use of crop-rotations, inter-cropping practices and dung. This tendency to rely more on chemical fertilisers for maintaining the fertility of the soil relative to other better and cheaper methods has been criticised by ecologists and other specialists. Thus Francis Moor Lappe and Joseph Collins write in their classic, *Food First* that "The more one relies on chemical fertilisers instead of manure, compost, crop rotation and green manure, the more the organic matter declines, the less able plants are to absorb inorganic nitrogen in chemical fertilisers. This helps to explain why US agriculture, according to biologist Barry Commoner, now uses about five times as much fertilisers it did in 1947 to produce the same amount of crop". In fact, the Punjab State Planning Board in a perspective plan for agriculture (1980-2000) notes that the heavy reliance on wheat-rice rotation has "upset the ecological balance of the state and the agro-ecosystem has become fragile".

In a country where purchasing power is concentrated in the hands of a small proportion of the population while the masses lack purchasing power, the rich spend extravagently on expensive food while the poor cannot even purchase essential foodgrains. The consumption of barley, used by the poor either as flour for making 'chapatis' or as parched grains to make 'sattu', has been declining. Instead barley is being diverted into the preparation of malt for producing beer, whisky, candy etc. The organisation of the milk trade has changed significantly in many areas. In earlier days when marketing of milk was not so extensive, a lot of milk used to be converted to ghee at the village level. A nutritious by-product called 'chaach' obtained in the process was consumed by the poor. Now, with extensive marketing facilities for fresh milk, lesser ghee is produced within the village and consequently the poor are deprived of 'chaach'. Thus, the poor are deprived of a significant share of milk-related proteins while chocolates and ice-creams are produced for the metropolitan market.

The export of rice, is clearly an undesirable trend. The existence of a 'surplus' stock is no reason for exporting especially when millions of hungry and malnourished people are deprived of adequate amounts of this staple food. Instead largescale employment generating programmes like soil and water conservation and afforestation could be launched.

India is the fourth largest exporter of tobacco. Tobacco not only takes up land that can be used to grow food crops but it also destroys the fertility of the soil. Export of fish and fish preparations has increased from 33,000 tonnes in 1970-71 to 90,000 tonnes in 1984-85. Capital and technology has been imported for deep sea fishing to step up exports, bypassing the protein needs of the poor local people.

The author outlines the elements of a solution, towards satisfying the nutrition needs of the people which include the implementation of radical land re-distribution, special attention to forest conservation, and a revaluation of traditional farming practices. These measures will face formidable opposition from the ruling classes. Thus they can succeed only as part of a wider struggle for social, economic and political emancipation of the oppressed.

The book is a competent, radical overview of the food system in India. The author however focusses on the problems of hunger and malnutrition in rural India, but the urban situation has not been dealt with adequately.

Vaccine Production in Private Sector

A Comment

r s dahiya and peeyush sharma

THE new drug policy was announced on December 18, 1986. The total thrust of the drug policy is antipeople—the prices of various drugs will increase substantially (50 per cent to 300 per cent). Also, the new drug policy has given undue concessions to foreign multinational drug companies and monopoly houses of India. The small and medium manufacturers along with public sector will get a set back with this new drug policy. Its above impact can be understood with one example.

Earlier all the vaccines were being manufactured by the public sector in India. There may be multi-factorial reasons for these vaccines being in short supply, but in whatever limited quantity, these were being provided to the general public free of cost in government hospitals.

One example can be taken that of antirabic vaccine. There have been many reports in newspapers about the short supply of these vaccines in governmental hospitals. The reasons of less production and lacunae in regular supply have not been thoroughly evaluated. The new drug policy has given the option to private companies to manufacture these vaccines.

One of the companies Behring Biologicals, a division of Hoechst India Limited has come out with an antirabic vaccine with a brand name of 'Rabipur'.

The various advantage of this vaccine over the already produced vaccine by public sector are documented as follow:

- New generation tissue culture vaccine.
- Potent.
- Safe.
- Economical.
- It is to be given intramuscular instead of intraperitoneal. The dosage is one injection on each of days 0, 3, 7, 14, 30 and 90 (hence less drop out).
- Rabipur should be stored protected from light at +2 to 8°C.
- Cost of 1 ml. is Rs. 100 whereas total dose is 6 ml. Thereby cost is Rs. 600 for one patient.

New certain questions can be raised.

How is it economical?

a) Its cost is Rs. 600 for one course whereas the cost of vaccines manufactured by public sector is Rs. 40 per vial, whereas this was given free of cost in the government hospitals.

b) Moreover immunoglobulins are also recommended along with Rabipur injections which entail further cost of Rs. 300-400.

c) Even a lay person can understand how far economical it is. Of course it can be said to be economical when the cost is, compared with other brand names where cost is Rs. 2100 for one course.

Is it potent and safe?

The advertisement pamphlet reads as under:

1. Slight reactions at the site of injection such as pain, erythema and swelling may occur in less than 5 per cent patients.

2. Isolated instances of lymphadenopathy, headache, lethargy, slight elevations of temperature and allergic reactions of skin have be reported.

3. No experiences are yet available with regard to administration during pregnancy.

4. This should not be used where there is a known allergy to neomycin, chlortetracycline, amphotericin B, or chicken protein. Prophylactic vaccination should not be undertaken.

The above statements made by the company themselves raise many suspicions.

1. Is the vaccine really as safe as claimed?

2. Will this be experimented on pregnant woman in India as many other drugs are being experimented. Does the company consider that Indian pregnant women are guinea pigs?

3. The only thing which is an improvement is that the route of administration is intramuscular rather than intraperitioneal but as the number of abscess formation in S/C or I/M immunisation is increasing who knows what will be the percentage of abscesses with this I/M injections.

The new drug policy by opening vaccine manufacture to private firms will only cater to the needs of those who can pay Rs. 600 to Rs. 2000 for simple antirabic vaccination.

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Myth of Alternative Medicine

thomas george

THE so-called 'radical perspective' of medicine has many degrees, but all of them agree that modern medicine is more or less bad, ineffective and expensive while traditional medical systems are projected as a sort of magical remedy to all health problems. This view has gone into the folklore of self-proclaimed 'radical' writers and has been repeated ad nauseam, without discrimination of scientific examination. A close look at this concept reveals several fundamental flaws; to the extent of making it a reactionary rather than a radical view point.

In the first place, the glorification of traditional systems is utopean and unrealistic. To keep recalling bygone 'golden ages' is fruitless. The fact is that at the present time, all traditional systems of medicine are primitive and ineffective in comparison to modern medicine. To call for research in these systems is one thing, to project them as qell-developed, near-perfect systems is quite another. In fact, the whole business of counterposing modern medicine and traditional systems, of making them appear antagonistic and mutually exclusive has no basis in reason. Any scientific system will incorporate the results of research and any boundaries are artificial and foreign to scientists. These boundaries definitely do not serve the cause of science and are of use only to vested interests who make a living out of such divisions. When one comes down to the nitty-girtty and asks for a point-by-point delineation of the ways in which traditional medicine is superior, one comes up, not against a wall, but against a mass of fluff—vague statements about being closer to the people, arising out of their milieu etc. When one is sick, it may be reassuring to see one's grandmother but far more effective to see one's doctor! All this boils down to saying that promising lines of enquiry in any system should be subjected to rigorous scientific research and the results integrated into the knowledge available in health care. To rigorously demarcate 'systems' is ridiculous, wasteful and unnecessary.

On the question of cost also, one finds that the idea that ayurveda, siddha or unani is cheap, an idea that the 'radicals' have been trying to ram into our minds, is far from true. These systems as they now exist are expensive, often more so, than modern medicine. In this context it is surprising how self-proclaimed socialists make such a fetish about cost. The ultimate aim of a socialist system is to provide the best life for its citizens, not the cheapest. In fact it is interesting that emphasis on traditional systems finds so much favour with foreign aid agencies, many of them wings of multinational companies, doing business by other forms. One possible reason for this favour is that giving respectability to all the quacks in the countryside is a cheap way of preventing rural people from demanding better health care. To provide really good medical care of the quality available in the west would be expensive. How much easier to give the shadow—and go on a propaganda campaign to pass it off as better than the substance! And it is this very ludicrous propaganda that the 'radicals' have swallowed. They have now put themselves in the silly position of saying that the best is too good for the poor, that they should have only what they are accustomed to—quacks and magic remedies!

The talk of community health and the attempt to produce non-existent antagonism between preventive and curative services, is all part of the attempt to cloud the real issues by posing symptoms of the disease as the disease itself. To cover up the lacunae in the health services and the wocfully inadeqauate budget spent on it by the expedient of posing it all as a problem of priorities is nothing short of criminal. And when 'radicals' accept this kind of solution, they in effect accept that the health budget is adequate, its all a matter of more judicious spending, they accept that the best care is impossible; attitudes that are not only defeatist, but a grotesque travesty of the truth.

The true radical viewpoint on health would be that the most scientific and effective system should be available to all irrespective of cost. One can accept compromises in the interim period towards achieving the goal, but any attempt to pass off the compromises as better than the goal itself should be stoutly resisted. We cannot accept second class care as good enough, for the poor. It is the duty of every democracy to provide the best in all fields for all its citizens and this is the objective for which we should fight.

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Why don't you write for us ?

This periodical is a collective effort of many individuals active or interested in the field of health or interested in health issues. The chief aim of the journal is to provide a forum for exchange of ideas and for generating a debate on practical and theoretical issues in health from a **radical or Marxist** perspective. We believe that only through such interaction can a coherent radical and marxist critique of health and health care be evolved

Each issue of the journal highlights one theme, but it also publishes (i) Discussions on articles published in earlier issues (ii) Commentaries, reports, shorter contributions outside the main theme.

A full length article should not exceed 6,000 words and the number of references in the article should not exceed 50. Unless otherwise stated author's names in the case of joint authorship will be printed in alphabetical order. You will appreciate that we have a broad editorial policy on the basis of which articles will be accepted.

We have an author's style-sheet and will send it to you on request. Please note that the spellings and referencing of reprint articles are as in the original and are NOT as per our style.

We would also like to receive shorter articles, commentaries, views or reports. This need not be on the themes we have mentioned. These articles should not exceed 2,000 words. Please do write and tell us what you think of this issue.

All articles should be sent in duplicate. They should be neatly typed in double spacing, on one side of the sheet. This is necessary because we do not have office facilities here and the press requires all material to be typed. But if it is impossible for you to get the material typed, do not let it stop you from sending us your contributions in a **neat handwriting** on one side of the paper. Send us two copies of the article written in a legible handwriting with words and sentences liberally spaced.

The best way to crystallise and clarify ideas is to put them down in writing. Here's your opportunity to interact through your writing and forge links with others who are, working on issues of interest to you.

WORKING EDITORS

PHYSICIAN'S OATH
AND
STATEMENT OF MEDICAL ETHICS

(Adapted for the nuclear age)

Over the millenia
physicians have evolved a long tradition of ethical affirmation, represented originally by the Oath of Hippocrates, and later by many other national and international codes and statements of professional ethical obligations.

Recently in May 1983
the World Health Organisation General Assembly stated that, 'nuclear weapons constitute the greatest immediate threat to the health and welfare of mankind', and that physicians 'have both the right and the duty to draw attention in the strongest possible terms to the catastrophic results that would follow from any use of nuclear weapons'.

To our long tradition of ethical statements
we believe that there should now be added:
"As a physician of the 20th century, I recognise
that nuclear weapons have presented my profession
with a challenge of unprecedented proportions,
and that a nuclear war would be
the final epidemic for humaking.
I will do all in my power
for work for the prevention of nuclear war."

Proposed at the Third Congress of International Physicians for the Prevention of Nuclear War. The Hague. June 17-21. 1983