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Study Them To Death

" The desire for hard evidence has left victims of Chernobyl disaster limiting nearly ten years, and much inaction has hidden behind what will always remain unquantifiable".

The Secretary General of The United Nations

The International Atomic Energy Agency has a vested interest to see that radiation health damage remains forever unquantifiable, as this state of "unknowing" favours the expansion of the nuclear industries.

Dr. Rosalie Bertell

A large international conference was held in Geneva on 20-23 Nov. 1995, on the consequences of the Chernobyl nuclear accident The most important item for discussion was a report of a study by the World Health Organisation (WHO) which involved 7,000 scientists. The main result: there is a lot more research necessary. This will take several years and will cost another US $200 million. The study which started in 1992, has already cost US $ 35 million.

At the conference, the atmosphere smacked of the victims being part of a gigantic experiment.Since medical ethics forbid deliberate large Kale contamination simply for the purpose of conducting research, the attitude seemed to be, if the people are contaminated anyway, you, as a scientist have a marvellous opportunity.

For instance, scientists of the Moscow Medical Radiological Research Institute investigated the teeth of 200,000 people. By measuring the quantity of carbon dioxide in teeth, scientists ascertained the level of radiation people received. A number of scientists reported during the conference that finding out the level of radiation received was not a piece of cake. Tens of calculation models had to be drawn up, and dozens of scientists were needed to resolve the problems which arose in the course of establishing those models.

A Urge number of scientists were also needed in investigating the levels of radioactivity on 1,8 million(l) farms. A voluminous population registry was established. This contained data on four million people

whose physical condition is under observation on a regular basis.

Various organisations made contributions to the WHO research. Between 1991 and 1995, the European Commission paid about US $ 30 million for 16 projects. Often the aim of these project was the transfer of technology for radiation measurements. Almost always, the technology transfer involved the education and training of people, mainly from the Ukraine, by experts from the European Union.

The WHO project is has been going on for two years now. Too short, says WHO, to get clear results. Many Russian researchers, who consider Chernobyl as " the most tragic accident in human civilisation", say that there "was never before a chance to conduct so much research on such a large scale". They want to continue the research because of this and also because, as N. Krysenco, Belarus' deputy-Minster of health, put it," we can expect a lot more consequences from Chernobyl".

What comes through is the fact that, health problems resulting from the accident are still increasing in the Ukraine, Belarus and Russia.

The people in radiation affected areas of Ukraine are more often ill — by 30 percent — than those in other parts of the country. Illnesses of the circulatory system have increased by 43 percent, bone and muscle illnesses by 62 percent, malignant tumours by 38 percent. Surprisingly, the report shows no increase in leukaemia.

One third of the liquidators from Russia, who had to work at Chernobyl after the catastrophe, are ill and cannot work anymore; two percent of them have died. A total of 800,000 liquidators from all parts of the Soviet Union were involved in the Chernobyl cleanup.

From the Editor's

This is Anumukti's fiftieth issue. Originally we had planned to bring out something special—A history of the experience of nuclear power in India in cartoons, However, doing that properly takes time and we are already so late that we decided to bring out issues quickly and get back on schedule and then try out new time-consuming propositions.

Publication of Anumukti began on 6th August, 1987, with the statement: "Nuclear power is an idea whose bright future is already behind it." During the last nine years, the truth of this has become all the more apparent. Even nucleocrats have begun to realise the writing on the wall but the chains of private profit are stronger by far than any rudimentary cognizance of harm caused to society at large by their activities.

Normally it has been our practice not to have long articles. But we have made an exception this time since we believe the issue of radiation protection is best presented by putting up the various different arguments in all their detail. Dr. Rosalie Bertell in a speech at Hiroshima has done this in a masterly fashion. In this issue, we have articles from both Dr. Alice Stewart and Dr. Rosalie Bertell—two towering personalities whose pioneering work has done so much to elucidate the harm caused by so-called "acceptable" levels of radiation. They demonstrate the fallacies involved in the setting of standards for safe levels of radiation. It is another story altogether that even these unacceptable and unsafe international standards are still not followed in India !

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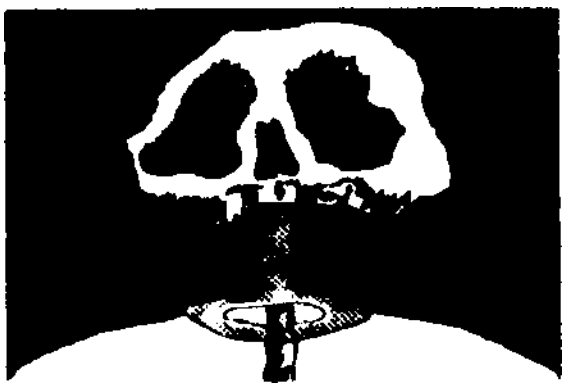
On the one hand aid organisations helping the victims are finding it difficult to raise funds. It was estimated in 1991 that it would need US $ 647 million to provide effective help. The amounts raised thus far have fallen far short of this and it is becoming more and more difficult to raise new funds. In the absence of scientific proof that the health damages are indeed the result of the accident, donors say that they cannot provide money to address 'normal' health problems in the Ukraine. On the other hand, according to a senior expert of the World Health Organisation, it will take at least 20 more years before a scientific study can be conducted.



Can Bhopal Ever Forget Chernobyl?

Bhopal was the turning point. Those eyes still haunt. But Bhopal was not merely what happened on the night of December 2 and the early morning of December 3, 1984. It is the abuse that still continues. The real disaster is the fact that corrupt people in power chose to associate with foreign peddlers of hazardous technologies and conspire against the interest and well being of theirfellow citizens.
Chernobyl is no different. Radiation community has defended its interest by denying the extent of death and suffering caused on the people involved whether they be children living in the vicinity or the 'liquidators'—a lot of whom were forced into 'volunteering' to contain the inferno.

The International Atomic Energy Agency is holding a Conference: "Once Decade after Chernobyl: Summing up of the Radiological Consequences of the Accident" in Vienna, Austria, 8-12 April 1996. Because we have watched the various attempts of the IAEA to minimise the radiological effects of Chernobyl over the past ten years, because the IAEA has a mandate from the United Nations to promote nuclear power and other nuclear technologies, and because ten years is insufficient time to allow for the development of most radiation related cancers, we believe that an independent international body, qualified to comment on the IAEA conclusions and to produce credible evidence to support its claims is a necessary international remedy for the potential damage which this IAEA Conference can cause. For these reasons we propose to hold a counter-conference in Vienna April 12-15, 1996 to undertake serious investigation of both the claims of the people most affected by the disaster, and those being attributed to the disaster by promoters of nuclear power.

The report of the Secretary General of the United Nations (Document of the General Assembly A/50/1995) specifically calls for the strengthening of international corporation and co-ordination of efforts to study, mitigate and minimise the consequences of Chernobyl disaster. In addition to the profound suffering of the people most directly affected by the disaster, there were serious violations of the human rights of the victims to understand what had happened to them and to receive assistance. There has been a remarkable imbalance in international responses to the disaster. Research activities designed to establish accurate scientific knowledge and assessment of radiation effects has often taken precedence over tangible financial and material assistance. Many nations have poured in money to map the radioactive fallout: create plans and mechanisms for possible future disasters of this nature which will take place elsewhere; develop practical means to deal with the economical consequences of contamination of food and land, and other activities basically designed to help the nucleariscd areas to the world, not the disaster victims. These international players also arc undertaking public relations damage exercise* so that people will tolerate the risks connected with further nuclear reactor proliferation.

Tribunal on the Consequences off the Chernobyl Disaster

Vienna, Austria,
April 12-15,1996

The victims have not only suffered from neglect, but they have also suffered from other people's denial of the reality of their experience. Mothers, concerned about the deterioration of the health of their children were told they had "radiophobia". Persons presenting at clinics with unusual illnesses which they believed resulted from their exposure were told that there would be no radiation effects for twenty years, and perhaps then they might develop a cancer. The denial of their experience was itself painful.

This mishandling of real health problems has worked directly against the pressing health and economic survival needs of the victims. The dispute over whether or not the observed severe problems of health, especially among the children, are attributable to radiation or to other factors, has deterred many nations from helping the 400,000 displaced persons and many other severely af-

fected, survivors. All three nations close to the disaster have experienced declines in their GDP: Russian economy declined 16% in 1994 from its 1993 level; the Ukraine declined 25% over the same year; and Bylorussian economy declined by 20%. These declines follow several years of declines averaging between 14 and 17% per year. The impact of the necessity to meet the urgent medical requirements of liquidators, children, displaced persons and elderly, plus the need to redress Chernobyl's environmental and economical impacts, has devastated the shrinking economics. Belarus has had to devote 20% of its national budget expenses each year for the mitigation of Chernobyl consequences, Ukraine devotes 4% (although it maintains that it should be spending 20% at least) and Russia has maintained 1% of its national budget devoted to Chernobyl problems. The permanent contamination of much of their prime farm land further complicates the health, social and economic future of these countries. In the face of such monumental problems, trying to counteract the denials of their reality in the international circles which might have helped them had they known the truth, has become nearly impossible. It is time to bring international attention to their plight.

The secretary General of the United Nations states:

** The desire for hard evidence before action has left the victims of the Chernobyl disaster waiting nearly ten years, and mush inaction has hidden behind what will always remain unquantifiable".*

The IAEA has a vested interest to sec that radiation health damage remains forever unquantifiable, as this state of "unknowing" favours the expansion of the nuclear industries. We fear that the IAEA April 1996 meeting will further deter nations from helping the victims, and furthermore will be designed to promote nuclear technologies in the Developing Countries, assuring them that the Chernobyl problems are minor and not related to nuclear technology itself.

In response to this event, the International Medical Commission Chernobyl has been formed and has joined with the Permanent People's Tribunal to carry out the following purposes:

- 1 To provide for a fair and unbiased hearing of the concerns and evidence which have been gathered by our colleagues in Belarus, Ukraine and Russia relative to the radiological and non-radiological consequences of the Chernobyl disaster,

- 2 To provide for a fair and unbiased hearing of the concerns and evidence which has been gathered by our colleagues in Belarus, Ukraine and Russia relative to National and International responses to their needs for compassionate assistance after the disaster,

The International Medical Commission hopes to develop an international voice for honest and just dealing with those who have already been victimised so that they are not victimised again

- 3 To provide for a fair and unbiased hearing of the response of our colleagues in Belarus, Ukraine and Russia to the pronouncement of the April 1996 IAEA meeting, as well as to prior documents which IAEA has released on the disaster and its consequences,

- 4 To judge the medical the medical and scientific findings at Chernobyl relative to the experience of the people of Hiroshima and Nagasaki after the dropping of the atomic bombs,

- 5 To examine the limited recognition of radiation related injuries among the atomic bomb survivors in light of the failure to recognise radiation injuries after Chernobyl

- 6 To examine the Human Rights violations of the atomic bomb survivors and the patterns of Human Rights violations observed at Chernobyl.

- 7 To provide fair, unbiased and independent judgements to the United Nations, the media, governments and concerned persons on the violations of human rights, scientific integrity and honesty which the IMCC and the PPT will be able to identify as part of the national and international response to the Chernobyl disaster.

The International Medical Commission together with the Permanent Peoples Tribunal have been responsible for the evaluation of the aftermath of the Bhopal disaster, and have been the primary forces behind the development of International Law to provide remedies to victims of technological, industrial and medical disasters. By their distinguished panels of physicians, scientists and jurists, the IMCC and PPT hope to develop an international voice for honest and just dealing with those who have already been victimised so that they are not victimised again in the national and international responses to major disasters.

Dr. Rasalie Bertell

Tho Ruison d'etre

Why was "The Peaceful Atom" invented?

A Bomb with No Upper Limit

US military had six bombs at the end of World War II. Two were dropped on Japan, leaving four to be used in "tests" which they decided to conduct in the Pacific Islands. Testing at Bikini began in the summer of 1946, even before the United Nations had given the territory of Micronesia into the "protection" of the US as a Strategic Trust Territory. The Trust was not established until 1947, and it was only the UN ambassador from Australia who objected. The whole world knew that the US was already using the Atolls as a nuclear weapon testing range. The Australian Ambassador resigned, was replaced, and the vote taken in favour of US possession. The world looked the other way as the 32,000 people of the Marshalls were subjected to some 68 nuclear tests.

Atomic bombs had proved to be limited in size. In order to induce sustained nuclear fission, the chain reaction which produces all of the energy, the uranium 235 atoms need to be brought very close together so that the neutrons released in the splitting of one atom can reach other atoms and continue the splitting. In an explosion this fissionable material is blown apart and the reaction stops. The first hydrogen bomb explosion occurred in March of 1954 at the Bikini Atoll in the Marshall Islands. We, in North America, did not know what had happened to the Rongelap People and the other Marshallese. Nor did we really understand that this new hydrogen bomb provided the military with a bomb which had no upper limit in detonation power. The bomb was based on fusion rather than fission. In fusion, atoms are forced together rather than blown apart, and in the process they release an almost unlimited number of neutrons. The energy for fusion was produced by a fission detonation. The neutrons produced by the fusion were then absorbed into a blanket of fissionable atoms producing detonations in the megaton rather than the kiloton range.

The Peaceful Atom Programme

In the wake of the Bikini test, the military decided to change the whole arsenal to thermonuclear devices—hydrogen bombs. For this it required extensive uranium mining, a series of large production facilities to enrich the uranium, bomb production factories, and public tolerance of the waste from all parts of the cycle. They also needed the co-operation of society with the transportation of radioactive material, radioactive effluents from nuclear facilities and uranium support industries. The military needed co-operation from the universities in preparing nuclear engineers and physicists to staff its technical needs. All of this would be impossible during peacetime when the only purpose was producing weapons of mass destruction. They were already experiencing the rumbles of anger over the Nevada Nuclear Testing Site, established in 1951.

Shortly after the hydrogen bomb explosion in March of 1954, President Eisenhower made his Peaceful Atom speech in the United Nations, an people were told that this awesome energy was now tamed and could produce unlimited amounts of electrical energy. It would produce electricity too cheap to meter. It would instantly bring developing countries a modern standard of living. There would be no more war, because the whole world would have as much of the good things of life as they could ever desire. For a world just beginning to understand Hiroshima and Nagasaki, and the potential atomic megadeath, this promise of something wonderful for humanity arising out of the ashes was intoxicating. Academics, who abhorred the bomb began to study nuclear science. It became popular in schools. People became willing to mine uranium and to tolerate the effluents and waste. Nuclear engineers and physicists became like gods, and they were admired for the intelligence and their ability to attract government grants. They were superhumans, privy to secret of the gods which were totally beyond the understanding of most people. The peaceful atom myth was very successful in the public support, without which the build-up of nuclear weaponry would have been impossible. Most of the civilian enablers of this military addiction were completely unaware of their own roles. Even anti-war activists joined in.

The United Nations' response to Eisenhower's speech was to establish the International Atomic Energy Agency (IAEA). This new agency was given two mandates: to prevent the horizontal proliferation of nuclear weapons, and to promote peaceful uses of nuclear energy. It has no basic mandate to abolish nuclear weapons or to promote health and safety relative to nuclear technology. The IAEA is still busy trying to find medical, agricultural and commercial uses for nuclear energy. More recently, it has been promoting the image of nuclear power as a "safe, clean technology" by downplaying the radiological consequences of Chernobyl accident. This

doubly victimises the people who lived near the reactor: first they were innocent victims of the disaster and now their illnesses and sufferings arc being denied. I think the people of Hiroshima and Nagasaki or Bhopal can understand this injustice.

One of the physicians who served at the Bikini Atoll gave up the practice of medicine after he saw what the radiation effects were on the sailors sent into ground zero after the tests. All of the health damage was classified as secret, even from the men themselves.

Dr. Rasalie Bertell
from a talk delivered on the 50th anniversary cf Hiroshima.

Possible Fallacies in Present Cancer Risk Estimates

Dr. Alice Stewart

Exposure to radiation is an occupational hazard for those working in the nuclear industry or in medical radiotherapy; it is well-known that radiation can induce cancer in tissues. But there is a widespread belief that my monitoring radiation exposure of workers and making sure exposure never exceeds a recommended annual 50 mSv dose-related cancer risks have been kept at near zero level.

For example, a study on occupational dose and subsequent cancer risk published in 1990 by the US Committee on Biological Effects of Ionizing Radiation (BEIR) indicated that even an annual dose of 10 mSv per year for 48 years—ten times higher than the average for all badge monitored workers at the Hanford nuclear facility in the US—the risk of cancer death would still only be 23% compared with a general population risk of 20%.

As a rule, risk estimates arc derived not from occupational data but from epidemiological studies of Hiroshima and Nagasaki A-Bomb victims. Hanford became operational in 1944, time enough for some direct risk estimates to be made". However, this is deemed unnecessary since both BEIR and the International Commission for Radiological Protection (ICRP) arc of the belief that the A-Bomb data and its interpretation by the Radiation Effects Research Foundation (RERF) offer reliable risk estimates for all occasions. This consensus has now lasted for thirty years and is now so strong that only risk estimates which conform with A-Bomb data arc allowed to influence radiation safety regulations.

A-Bomb data collection and analysis left room for different conclusions to be drawn, conclusions sometimes contradictory. The original interpretation is subscribed to by the establishment, but may be flawed

Study subjects were assembled five years after the event and included those with inutero as well as post natal exposure. The then Atomic Bomb Casualty Commission — now RERF — took all survivors within a 2.5 km radius as 'cases' and the 'control' consisted of two groups, from greater distances, of the same size, age and sex composition as those cases under two kilometre.

Here then was the first mistake in data collection. By comparing matched samples which differed only in their distance from the hypocentre, ABCC failed to facilitate the easy interpretation of age at exposure related radiation effects. Given this less than perfect data base, subsequent mistakes, this time in data interpretation by RERF, exacerbate the problem.

RERF presumed an even spread of high to low doses across all ages of exposure. The evidence shows that high dose survivors were mainly young adults, suggesting some sort of survival of the fittest selective process by the high dose radiation. This theory is given added weight by the fact that the deaths before ten years of age of children of these surviving young adults was much smaller than the expected number.

RERF deduced no increase in non-cancer deaths as a result of the radiation. If the A-Bomb surviving population is compared to the controls, no significant differences arc found in the rate of non-cancer deaths. There is a presumption here of two like-for-like populations being compared. However, it may be that the non-specific effects of the A-Bomb left a highly selected population which would be less likely than normal to suffer any kind of death at a particular age. If the radiation nevertheless caused bone-marrow damage in these survivors (a cell killing effect), this would have the effect of increasing their chances of later death (deaths from aplastic anaemia—a disease arising from bone marrowdestruction—were unusually common before 1950). Thus these two opposite effects of increased and simultaneously decreased chance of survival would cancel each other out, masking a real increased risk of non cancer deaths caused by radiation.

According to RERF, although the effects of foetal radiation include brain damage, young embryos were not affected Hence, a widespread assumption that until eight weeks of foetal age the human embryo is immune to any brain damage effects of radiation. This is despite the fact that there was a significant deficit of births *seven* to nine months after the bombing, suggesting that doses of radiation were sufficient to kill embryos.

Finally, a total absence of childhood leukaemias in children born after inutero exposure to the A-Bomb is in direct contradiction to the findings of the Oxford Survey of Childhood Cancers (OSCC) which found a positive association between foetal irradiation and childhood leukaemia. This difference was originally ascribed to faulty interpretation of the OSCC data relating to prenatal x-rays. But work by my colleague George Kneale has shown that the latent phase of childhood leukaemia is characterised by an increased infection susceptibility. Coupled with the above mentioned probable lethal A-Bomb radiation effects on young embryos this suggests that the difference *is* more likely due to prenatal and post-natal death of the Japanese children, before an age when childhood leukaemia would become apparent

An alternative analysis

ABCC had collated data on sustained acute injuries effected by the blast, but considered the resultant variables of little value in analysis. RERF released the data to Knealc and he carried out his own statistical tests. If those with the highest level of multiple acute injuries are considered as the closest possible approximation to the original population, i.e. the unselected population, then findings for this subset might give some insight into the selective process.

Acute injuries were categorised as burns, oropharyngeal lesions, purpura and epilation. Using injury as a variable, various additional findings were uncovered: a strong association between injuries and leukaemia; doses sufficient to have non-cancer effects were not confined to those with obvious injuries, supporting our theory that sustained injuries included bone-marrow loss, leading to aplastic anaemia; a disproportionately high number of very young and very old people were among those with multiple injuries, which could be interpreted to mean that these people, most close to death, had been selected against by the A-Bomb.

The radiation community is of the belief that the A-Bomb data offer reliable risk estimates for all occasions. This consensus has lasted for thirty years and is now so strong that only risk estimates which conform with A-Bomb data are allowed to influence radiation safety regulations.

Potentially wrong risk estimates based on A-Bomb data may have consequences for recommended safe levels of worker exposure. Pooling of monitoring records of nuclear installation workers from three countries, the US, Canada and Britain, has resulted in no findings of any dose related cancer risk, according to researchers from the International Agency for Research on Cancer (IARC). The risk estimates agree with those from A-Bomb data. It has been noted, however, that the IARC researchers failed to appreciate that relations between exposure age and cancer risk are very different for workers and A-Bomb survivors, and they mistakenly assumed that the dosimetry standards within the nuclear industry arc sufficiently uniform to allow pooling of data from several facilities.

Work by Kneale et al has shown that if the data is disagregated and then analysed, evidence can be found of a cancer risk much greater than any A-Bomb estimate. Kneale has also shown that for workers in the US nuclear facilities the cancer risk increases progressively with age when exposed RERF has repeatedly shown from the A-Bomb data the exact opposite — that cancer risk was lower for those exposed at an age 50 years and over compared to those who were under 50 years at the time of bombing.

Clearly, application of A-Bomb data to very different sets of circumstances, flawed or not in its interpretation, is invalid

The supposition of no low dose radiation risk to early embryos, based on A-Bomb data interpretation, has obviously been influential in clinical practice. It is possible that the risk of foetal exposure has been dangerously underestimated, as evidenced by findings of the OSCC study.

Entrenched as it is in estimating cancer risk, A-Bomb data is showing no signs of being superseded in its use for setting safe exposure levels. It is still regarded as the gold standard. In its latest report, IARC makes no reference to the work of those proposing an alternative A-Bomb data interpretation.

Revisions of cancer risk estimations are bound to be sensitive, and no one wants to be alarmist. But if the nuclear industry persists in purporting its safety, surely there is an obligation for it to take on board the strong doubts as to the advisability of relying on A-Bomb data for the setting of safety limits for foetuses, young children and adults over 50 years of age.

Dr. Alia Stewart
Soft Energy 107,
December 1995—February 1996.

Trivialising Tricks

The Inside View from a Modern Believer in Human Sacrifice

Dr. Morris Rosen

Dr. Rosen, the author of this article is the director of the International Atomic Energy Agency (IAEA) Division of Nuclear Safety, and assistant director- general of the whole organisation. Some time ago, the French government in collaboration with IAEA organised a conference in Paris on "comprehending" radiation risks. The following is an extract from a speech Dr.Rosen made to the conference and shows very clearly the mindset which trivialises other people's suffering to sustains one's own high-flying lifestyle.

Comprehending radiation risks is a real and major problem confronting society today. Perhaps every professional working in this field has had experiences similar to one I will share with you. Frequently during my air travels, I enter into conversation with my neighbour — generally a well educated professional. In a few minutes he discovers that I am involved in nuclear safety and inevitably the conversation turns to questions about radiation and its health effects.

"What can you tell me about Hiroshima or about the vast environmental contamination caused by Chernobyl?" I begin my answers by explaining that as we speak we are being constantly bombarded by a broad range of radiation, not only from the cosmos but also from the food we are consuming. That seemingly new and troublesome point is followed by my comments explaining that the many victims of Hiroshima were not killed directly by radiation, but by the explosion and heat wave created from the nuclear detonation. Of the 80,000 survivors who received very high doses of radiation, less than 500 have incurred illnesses so far which are attributable to the radiation exposure - a statement that is also new and received with disbelief. But the figures are scientifically factual.

It is interesting to note that while (the average dose received by the Hiroshima survivors) is considered by Mr. Rosen to be very high, higher doses received by radiation workers are considered "acceptable and safe" by radiation experts like Mr. Rosen!

About 8000 survivors have indeed died from solid cancer tumours, but epidemiological studies indicate that less than 500 can be attributed to radiation effects. The remainder are normal tumours of the type that will threaten all of us, whether survivors of Hiroshima or not. It seems that most of us, even the professionals, do not realise or want to acknowledge that cancer is a very common occurrence. Twenty- five percent of us will incur a fatal cancer.

[What Rosen doesn't mention here is that radiation exposures produce an excess of so-called 'normal' cancers, not to mention other forms of dis-case and morbidity]

The answer to my neighbours second question concerning Chernobyl elicits the same disbelief. Certainly the fact that the entire environmental contamination of Chernobyl has produced a global radiological impact equivalent to an additional world exposure to 20 days of natural background radiation is more difficult to comprehend, let alone understand. The same is true of the health effects to the surrounding population which, except for the apparent, expected, and regrettable increase in thyroid cancer in children, will be sufficiently small so as not to be discernible through epidemiological studies.

[Especially radiological studies designed specifically not to pick up any excess in health effects like the IAEA conducted Chernobyl study which left out all the liquidators who were the people most at risk. It is also worthwhile to note that while Dr. Rosen how finds the 2500 % increase in thyroid cancers among children to be " apparent, expected and regrettable" he did not do so in 1986 when he wrote his first paper regarding the accident's consequences.

Why does my neighbour not believe me? [It would indeed need an extremely gullible neighbour who would!] Certainly, his perception of the facts is different from mine. Why? Many of us have been very pessimistic about our ability to deal with the public's perception of radiation risk. Radiation is mysterious; It is invisible, intangible, odourless, silent, and associated with warfare.

To explore this issue in more depth, the IAEA in October 1994

organised upon the invitation of France an International Conference on Radiation and Society: Comprehending Radiation Risk. It attracted more than 400 participants from 50 countries and nine international organisations.

The conference sought to bring about a better comprehension of the risk attributed to the exposure to ionising radiation. This is an important and serious subject for all of those concerned with the uses of atomic energy and ionising radiation for health applications, improving the food supply, generating electricity, and producing consumer and industrial products [vital items like radioactive golf balls from Atomic Energy of Canada Ltd, or radioactive black diamonds from our own Bhabha Atomic Research Centre].

The large audience—a unique mixture of technical specialists, social scientists, decision makers, and media professionals—was an indication of the high level of interest in radiation and how individuals and society perceive its effects. [It was also an indication of how avidly this class of people takes to free trips and hospitality at government expense!] The conferences goal was hot a further elaboration of technical information, but a better comprehension of radiation risk. And by comprehension, the conference had certainly desired to promote not only an understanding of the scientific facts of radiation health effects, but also and more importantly an ability to express these facts in a form useful to the public and the decision makers.

The goal was ambitious, perhaps too ambitious. The conference had only limited success in satisfactorily dealing with the question of the comprehension of radiation risk. Yet the concerned specialists may have gained some better insights as to where the roadblocks to better comprehension lie. There arc many.

Scientists too often speak to themselves and this pattern was very evident during many of the conference sessions. There could have been more efforts to present facts and conclusions in an understandable and communicative language. Some specific examples may be illuminating:

Dr. Rosen: Although the action of sharpened *steel* on the jugular does often regrettably result in death, just think you are the only case involved !

Victim: Hey! it is my life !

It would have been useful to further discuss the implications of some remarkable facts among the 80,000 survivors of Hiroshima. Fewer than 500 have so far incurred a fatal cancer attributable to radiation exposure- and the average loss of life expectancy among the survivors is about 1 year, while those that have incurred the fatal cancer have had their life cut short by 10 years.

[There arc a few other things Rosen could have mentioned here, including just what could he possibly mean by 'a fatal cancer attributable to radiation exposure' when it has surely been known for years that radiation exposure raises the probability of occurrence of all cancers, not simply those most attributable to radiation. In addition, it has been suggested that exposure to radiation increases the incidence of all diseases, 'radiation related' or not. The implications of the fact that radiation doses to Hiroshima survivors have in the past been overestimated, and that corrections to the dose received by them has resulted in considerable decreases in the quantity of radiation needed to increase the probability of a given health effect could also have been discussed, as could the fact that that more vulnerable people would have died quickly from blast and injury, leaving only the toughest to survive afterwards... indeed, all of these things, not mentioned by Rosen, could have been mentioned.

It would also have been desirable to discuss the reported thyroid nodule cases in the Marshall islands and in Nevada by not only confirming that large exposures to radioactive iodine produces cancer nodules, but by also referring to the rather relatively small number of cases involved (Sec Cartoon)

As for the Chernobyl studies, speaking about a 2500% increase in thyroid cancers in children ignores the importance of the accuracy of the pre- Chernobyl reference value for these studies, which surely involves major uncertainties. It would have added more to the comprehension of health effects to have expressed the results as five cancers per 100,000 children and to refer more precisely to the total number of cancers to be expected in the various regions. An unemotional discussion of the clinical outlook for these children would also have been useful.

[A little unemotional history would be of interest here. Before the

Chernobyl disaster there used to be barely one case a year of thyroid cancers in children in the Gomel region. After the disaster the number became 130. When doctors from Belarus reported this finding to the British scientific journal "Nature" it was denied publication because experts and scientists of the radiation community refused to believe "in the light of Hiroshima data" that so many thyroid cancers would become apparent so soon. However, the government of Belarus supported its doctors and asked for a team from the World Health Organisation to come and confirm the findings. It was only when this team did do so, that the results were allowed publication. By, now casting doubt on the reference value i.e. the number of cases occurring before the disaster, Dr. Rosen just wants to obfuscate matters. Also a statement like only five cancers per 100,000 children without simultaneously mentioning the 'normal' incidence of thyroid cancer is bound to mystify rather than clarify people's comprehension of radiation risks.]

There were a number of references to the cardiovascular effects of radiation. This effect must be clearly qualified by indicating the many compounding factors and the more likely cause, which is other factors such as stress.

[Indeed, stress is a factor in cardiovascular disease, as it is in cancer, and a number of other diseases. So also arc diet, the presence of carcinogens both chemical and radiation, and heredity. But Dr. Rosen seems to be trying to say that if stress is a factor, which it certainly is, then radiation cannot be—which is by no means true. Also there can be no doubt that a radiological disaster in the vicinity is bound to increase stress and it makes no difference to you whether you die or arc crippled by a heart attack that was "due" to radiation or due to stress induced by radiation.]

In the discussion of cancer clusters, such as leukaemia clusters, it is necessary to repeatedly emphasise that clusters always exist in nature. They have been found long before nuclear power existed and are also found in locations remote from nuclear installations - and in any case the number of excess cancers are few. Discussion of the Seascale cluster (reported in the 1980s in the United Kingdom) lingers on although most involved scientists believe it is not in any way connected with radiation. Why are the profound limitations of linking clusters to any cause not clearly and repeatedly stated? Furthermore, in much of the scientific community, epidemiology is recognised as an observational science with severe limitations. Epidemiological studies often involve small numbers of excess cancers with substantive compounding factors such that for most situations, positive as well as negative results must be taken with caution. The profound limitations of epidemiological studies must be clearly and repeatedly stated.

It's fair enough to call for humility and caution in interpreting a result. But the problem is that Dr Rosen will be much less humble and cautious when he thinks he has a result that exonerates radiation. The problem with the Seascale results seems to have been that the reported emissions of radiation from windscale/sellafield have been 'too small' to account for the observed effect under the official dose/response model, depending exactly which one we may use, as even the official model has seen very substantial downward revisions in the amount of radiation required to produce a given probability of a cancer, leukaemia, or other health effect. And if (as at Seascale) an unusually high incidence of a condition which even Dr Rosen recognises as 'radiation related' is happening in a community living next to a nuclear plant that is known to have leaked and to have had a very poor safety record, and if that incidence is especially high amongst children of plant workers who have been exposed to radiation as is the case at Seascale, then it really seems to be asking a lot of our credibility to say that the exposures arc 'not enough' to account for the result. It would really seem more probable either that more radiation has been released than we have been led to believe or that radiation is a much more potent agent of morbidity and mortality than we have been led to believe - or both.]

Rosen concludes:

The IAEA, together with the European commission and the World Health Organisation, has also organised a major international meeting in April 1996 to further look at the health and environmental consequences of the Chernobyl accident—10 years after the disaster. It is hoped that after the meeting, there will be a better comprehension of the radiological consequences of Chernobyl."

Indeed, one would hope this would be the result of such a meeting. Given the previous record of the IAEA in denying any real health effects at Chernobyl in spite of their grossest manifestations, and attributing the reports of vastly increased rates of not merely "radiation related' cancers , but dis-ease of all kinds to 'radiophobia', one cannot but wonder if this IAEA conference will be anything but a massively expensive exercise in whitewashing. A parallel alternative conference is also being held in Vienna and another in Kiev by the antinuclear movement just to ensure that an accurate picture has a chance to emerge.

M. Rosen Bulletin of International Atomic Energy Agency, Comments by John Hallam and Surendra Gadekar

The Rigmarole Regarding Radiation Protection

Do radiation safety standards protect health?

Dr. Rosalie Bertell

Originally, the US military thought that the radioactive fallout from their bomb tests would "only" spread over about half of the Northern Hemisphere. They found that the lethal cloud circled the earth about two and a half times. The three nations which had produced these bombs, US, UK and Canada had different radiation protection standards at the time, and they were afraid *of* some 'neutral' nation bringing a law-suit against them for the fallout The nuclear physicists from the three countries met between 1945 and 1950 to hammer out an agreement on "radiation protection" standards which could then be promoted globally. This committee of physicists was called the Tolerance Dose Panel, indicating a belief that people would be able to "tolerate" and adapt to increased radiation pollution in the nuclear age. The medical communities in both Britain and the United States were alarmed, and they organised two other investigating committees on radiation protection standards. In Britain, it was the National Radiation Protection Board (NRPB) funded by the government, and in the US a committee called BEIR - Biological Effects of Ionising Radiation, funded by the Rockefeller Foundation. The physicists decided that 15 rem (150 mSv) per year and 1.5 rem (15 mSv) per year for the general public was a reasonable trade-off between cancers likely to be caused by the exposure and the benefits of the activities which caused the exposure. At the time the "benefits" were atomic bombs. The NRPB and BEIR decided that 5 rem (50 mSv) per year for workers and 0.5 rem (5 mSv) per year for the general public was a more health protective alternative than that proposed by the physicists.

Radiation Dangers: Not a Novelty

Prior to 1950. radiation protection standards were based on protection against skin burns. It had been known since about 1912, however, that radiation also caused cancer. This became even more painfully apparent with the deaths of the deaths of the radium dial painters. In 1943, Hermann Muller received a Nobel Prize for showing that radiation caused genetic damage in fruit flies. During the 1945-50 period, several different biological endpoints were considered on which to base radiation protection standards: skin damage or other injuries, fatal tumours, general effects on blood, cataracts, obesity, impaired fertility, shortened life-span, or genetic effects. The committee decided to base the standards on fatal cancers, and since then the arguments have centred around just how many fatal cancers would be caused by exposure of the Standard Man to one rem (or equivalently 10 mSv) of whole body ionising radiation exposure. The carefully worded statement is: **What people should be concerried about after radiation exposure is fatal cancer." The* many other possible damages have faded into the background.

The International Commission for Radiological Protection

In 1928, radiologists had formed an international organisation to compare their experiences with exposure to medical X-rays and to protect themselves and their co-workers from harmful effects. In 1952, the Manhattan Project physicists who were trying to decide on common radiation protection standards approached this group of radiologists and suggested that they combine into one group. The physicists agreed to not ever limit medical use of radiation on patients, but only to set standards for worker exposure and exposure to the public from nuclear industries. They proposed their 15 rem limit but were ultimately prevailed upon by others to reduce this to 5 rem per year. The merger of these two group was called the International Commission of Radiological Protection (ICRP). ICRP now claims that it began in 1928, when the radiologists first organised, but that was a very different organisation.

ICRP is a self constituted organisation. Since 1952 it has maintained a membership of about 50% physicists and 50% medical doctors. The doctors have been about 25% medical administrators (often from nuclear weapon countries) who set radiation protection practices in their National Ministries of Health or Labour and about 15% medical radiologists. The other 10% has consisted of one pathologist, 2 geneticists and some biophysicists. By their rules, the Main Committee, responsible for all decision making, will not ever include an epidemiologist, occupational health specialist, public health specialist, oncologist or paediatrician. One can say that it consists only of users of radiation and administrators. These were approved by the Executive Committee of the International Radiologists Association at first, and then by the ICRP's own Executive Committee. Mem-

bership term is for an unlimited time. They have not mandated themselves to be protectors of worker or public health, but rather to recommend "sensible" trade-offs of health for the benefits of their activities.

By 1957 the ICRP got out its second publication, recommending that the internal radiation dose to workers and the public be limited to 5 rem (50 mSv) per year of any ingested or inhaled radio nuclides. The committee originally intended that this be a combined external plus internal dose limit of 5 rem (personal communication, Dr. Karl Z. Morgan, Chairperson of the Internal Dose Committee of ICRP). Actually, it was often interpreted to mean the worker could get both internal and external doses per year. There was another abuse related to internal contamination, i.e. when radionuclides were ingested or inhaled and became incorporated into bone. The nuclear experts counted only the 4 or 5% of total dose delivered the first year and then forget about the subsequent years. Slowly delivered doses due to bone incorporation could continue for 50 to 60 years.

ICRP Publication 2,1959 states:

"The permissible dose for an individual is that dose, accumulated over a long period of time or resulting from a single exposure, which, m the light of present knowledge carries a negligible probability of severe somatic or genetic injuries, furthermore, it is such a dose that any effects that ensure more frequently are ~~limited~~ to those of a minor nature that would not be considered unacceptable by the exposed individual or competent medical

It is important to note several things: First dose rate is not considered to be important; second only severe effects are prevented, and third, the probability of more frequently experienced effects is admitted but dismissed as *not unacceptable.* The recommendations are resting on several value judgements and not on objective norms protecting health. Effects of a *minor nature* include non-fatal cancers, embryonic and fatal loss, still birth and congenital malformations or diseases which are not inheritable.

The Debate Regarding Genetic Damage:

On 6 February 1947, Professor D. G. Catchside, member of the Faculty of Botany at Cambridge University, prepared a memo on: "the genetic effects of irradiation with reference to man", and sent it to the British Medical Research Council subcommittee on radiation protection standards. He testified that even the smallest dose of ionising radiation caused genetic effects. His own experiments included doses down to 0.1 rem (1 mSv) per day on mice. All genetic effects from X-ray or gamma rays were cumulative, either additive or proportional to total dose. Even when the dose rate was lowered, genetic effects were additive. He was concerned about the doses to human ova and sperm.

Catchside was answered by Dr. D. E. Lea in a memo to the Medical Research Council dated 28 April 1947.

"In writing this memorandum I assume members of the panel to be familiar with and accept the survey of Genetic Effects of Radiation prepared by D. G. Catchside." He suggests accepting the observations but not trying to prevent the problem since: It will not be possible to prove whether any particular instance was caused by radiation, so no question of liability for compensation can occur." Lea stated this twice, first with respect to deleterious effects caused by recessive gene mutations and second, with respect to semi-sterility. Lea concludes: "so long as less than 1% of the population is exposed to radiation then is not likely to be a noticeable increase in of hereditary abnormalities."

Apparently this dialogue was passed on to the Tolerance Dose Panel of nuclear physicists, because they held a meeting on genetic effects in April of 1948. No minutes are available from this closed meeting. Some members of the Tolerance Dose Panel went on to found the ICRP, and were members of the Main Committee when the question of genetic effects surfaced again in 1957.

Professor Catchside delivered a paper, "Genetic Effects of Radiation" at the Conference on the Biological Hazards of Ionising Radiation at Cambridge in 1950. He stated clearly:

"There is no threshold, no time factor (latency period) and no recovery".

"The genetic defects would consist in part of obvious and gross ones and in fart of the minor ones which tend to reduce the fitness of many apparently normal individuals. The latter effects may well be rather considerable and more important from the point of view of the species as a whole. The total effect may well be very serious or even disastrous.[39]

The same caution was echoed by Hermann Muller, who was by that time a member of the ICRP Main Committee. This position is detailed in: "Radiation and Heredity", American Journal of Public Health, Vol.54 No., pp 42-50, 1964, in an article which Muller published.

While both Catchside and Muller based their concerns on animal and plant studies, I had reached the same conclusions after studying the effects on medical diagnostic x-ray exposure. In the childhood leukaemia data, leukaemia was a late-death phenomenon. What I mean by this is that large numbers of embryonic and foetal deaths, neonatal or infant deaths also occurred in the infant group. The number *of* such deaths was significantly higher than the losses in the unexposed group. The final deaths in the birth cohort occurred after one year of age and were leukaemia (or other cancer) deaths up to age 15 years. I reported this in "Radiation Exposure and Human Species Survival", Environmental Health Review, Vo.25No.2(1981).

My reasoning was that if medical x-ray during pregnancy was so lethal, it was very likely that many more babies who survived were damaged in some way. After exposure to a trauma capable of killing, it is unlikely that survivors had no residual problems. These were of course, hard to detect since there was no way of knowing the potential health of the offspring had they not been irradiated.

It was Professor K. Mather, Department of Genetics, University of Birmingham, UK, who answered the objection that there would be a "slow loss of fitness in the population" with chronic exposure to radiation. Mather takes courage in the "fact" that no more than 1% of the population would be exposed to radiation, but this was before the spread of nuclear technology and the fallout from nuclear testing programmes globally. He noted that:

"In particular, in human society, the fate of an individual is not independent of the activity of his fellows ... If his fellows take steps to alleviate his lot, his selective disadvantage will, at least in some cases, be reduced and bis contribution to the next generation increased... The point to be made clear is that, in the cast of man, discussion of the effect on the community of raising the mutation rate cannot be deponed from consideration of changes of

possible with other species." In Biological Hazards of Atomic Energy, edited by A. Haddow, and published by Oxford Clarmdon Press in l952).

This is the old discredited argument of eugenics. In its more modern form, it advocates amniocentesis during pregnancy and abortion of genetically inferior offspring. This docs not change the reality of the damage to the human gene pool. It only kills the victims who are most easily identifiable. There will be many more who will not be identified for years after their birth. The genetic load of the species will increase, and as Einstein said in 1945: "we will have fewer geniuses".

The Importance of Kerala Studies

The Atomic Bomb data has been recognised for many years as being inappropriate for the study of genetic effects of radiation. The United States National Academy of Science Committee on the Biological Effects of Ionising Radiation (the BEIR Reports) normally uses mouse studies for their risk estimates, although their cancer estimates arc based on the Japanese data. BEIR III (1980) contains a section called "Advances in Knowledge Since 1972" (pages 74-79). In this section the committee says, with respect to genetic damage:

"We cannot ignore such mild mutations... taken over the whole period and in conjunction with other mutants, their effect may be far from negligible. Despite a concern fir this effect, we shall not attempt estimating it quantitatively..

"In contrast to somatic effects, where the concern is concentrated mainly on malignant disease, the genetic effects are on all kinds of conditions, for the spectrum of radiation-caused genetic disease is almost as wide as the spectrum of all other causes.[v]

Recently the BEIR Reports have used atomic bomb data to support their theory that humans have undetectable genetic damage from the atom bombs. As early as 1957, the World Health Organisation called together a Committee to study the genetic effects of radiation and to recommend protection of the human gene pool. In the publication by this Committee, Kerala, India, was identified as the best place to study the genetic effects of chronic radiation exposure over several generations. To date, the nuclear establishment has not undertaken a serious study of this population, indicating their lack of concern for genetic damage. In one study, undertaken for another purpose, the authors noted that the exposed population of Kerala had an abnormally high rate of Down's Syndrome. Researchers also found significantly higher levels of broken chromosomes in the exposed group. In 1988, with the help of Indian re-

searchers, I agreed to act as scientific advisor to a study of the people of Kerala. Researchers found that they were the first group to interview and examine the population, although the nuclear industry often uses Kerala as its example to "prove" that low level radiation is harmless.

We now have measurements of the background radiation at grid points all through the contaminated area, detailed information on about 32,000 exposed households and matched control households not living on contaminated sand, and information on 92,000 pregnancies. Our preliminary findings are that the rate of Down's Syndrome is 3 to 4 times higher in families living on the radioactive sand than for control families. Other problems which were more than doubled for the radiation exposed group were: congenital blindness and deafness, epilepsy, malformation of long bones, childlessness (couples who wanted to have children but could not), and various kinds of degrees of mental retardation. In the communities living on the contaminated soil every one of the so called sentinel mutations, rare genetic damage, was found This was not true for the matched controls. We are still trying to raise money to complete the detailed analysis of this important data.

In my opinion, all future radiation protection standards should be based on damage caused to future generations. This will significantly lower the limits of exposure which are now officially considered "safe". It has serious implications for further plans to expand the nuclear industry and for the management of nuclear waste.

HOW MANY DEATHS ARE "ACCEPTABLE"

In basing radiation protection recommendations on fatal cancers, the ICRP makes a decision on how many cancer deaths per year arc "acceptable" for the activity (building nuclear bombs, generating nuclear power or caring for a patient with a radium implant). The fatal cancer risk is an estimate of how many cancer deaths arc expected for an exposure to 10 thousand Person Rem, or equivalendy, the exposure to 100 Person Sieverts. Prior to 1990, the official cancer estimates for this exposure were 1.25 (ICRP) or 1.00 (UNSCEAR - United Nations Scientific Committee on Atomic Radiation). I think that UNSCEAR merely rounded the numbers of the nearest digit.

There are also international guidelines for "safe industries", for example a chemical plant, which state that in a safe industry there will be no more than one death per ten thousand workers per year. A safe industry in a city is one which causes no more than one death per million people per year.

If one examines the ICRP recommendations for whole body exposure which govern the nuclear industry between 1952 and 1990, one finds that the maximum permissible dose to workers was 5 rem per year. If 10,000 workers annually receive that dose, the industry would cause 50,000 Person Rem exposure or five fatal cancers (using their risk numbers). Yet, they have never acknowledged this to be a hazardous industry. Instead, they claimed that workers only received an average of one rem per year not five rem, and therefore only one cancer death per 10,000 workers per year would be caused.

In 1990, the ICRP, after reassignment of doses to atomic bomb survivors and pressured by scientists and medical professionals globally, moved their risk estimate to 5 fatal cancers per 10,000 Person-Rem. This again makes the nuclear industry "hazardous on at one rem per year average exposure. It means that five fatal cancers are caused. The ICRP lowered its maximum permissible dose in 1990 to two rem per year, averaged over five years. Using their figures, this means a commitment to ten fatal cancers for nuclear workers per year is considered by ICRP to be "acceptable". Since 1984, the ICRP has admitted that its recommended exposure limits were: the upper limit above which everyone agrees that it is hazardous. Prior to that, the limit was considered a threshold below which exposures were considered safe.

The recommended maximum exposure for the members of the public at risk from nuclear industries was 0.5 rem per year in 1952. If one million people actually received this dose it would be 500,000 Pcrson-Rcm exposure. Using the ICRP risk estimate, this means 50 to 62.5 fatal cancers. This is a very unsafe standard even using ICRP calculations. The ICRP claimed that the maximum dose to the public was only one percent of that recommendation, hence the industry was "safe", but they would never lower this permissible dose. The one percent always referred to the reactor phase of the cycle (and was never demonstrated to be true when all radionuclides and all pathways to human were taken into consideration.) It was never claimed for uranium mining, milling or for nuclear waste.

In 1984, ICRP recommended that exposure to the public not average more than 0.1 rem per year. They did not specify the length of time this average was to extend Many governments, including Canada, averaged over the lifetime of the person (70 years) and thereby allowed

higher per year levels around nuclear reactors only expected to operate for 35 to 40 years.

In 1990, the ICRP risk estimate was changed to 5 fatal cancers and the maximum dose to the public averaged over five years was recommended to not exceed 0.1 rem. This is a commitment to 100,000 Person-Rem or equivalently to 50 fatal cancers per year. This is a very hazardous industry even under the assumptions which ICRP deem "acceptable".

Fatal Cancer Risks Based on Scientific Literature

The ICRP risk estimate is based on a double reduction of the observed fatal cancer risk at Hiroshima and Nagasaki. Under the same standard conditions, 10,000 Person-Rem, Dr. Preston, Research Director of the RERF at Hiroshima, estimated that 17 fatal cancers were caused using direct linear extrapolation from high dose. According to Dr. Preston, UNSCEAR 1988 report reduced this estimate because of a low-dose-factor to 7 to 11 fatal cancers. ICRP took the estimates from BEIR (8 to 14) and UNSCEAR 1988 (7 to 11), which averaged about 10, and divided them by 2 using a slow-dose-factor. Hence, the ICRP estimate of 5 is really quite low even based on atomic bomb data. The reduction of the estimate for low dose and slow dose rate has never really been shown to be a valid process. In fact, the most recent studies of nuclear workers, who actually received low doses at slow dose rates, indicate that the correct estimate would be around 20.

With a risk of 20 fatalities due to radiation exposure of 10,000 Person-Rem the "acceptable" number of deaths per year at 2 rem average exposure for workers and 0.1 rem average exposure for members of the public would be

Workers: 10,000 workers x 2 rem / year x 20/10,000 Person Rem - 40 cancer deaths / year

General Public: 1 million people x 0.1 rem/year x 20 / 10,000 Person rem = 200 cancer deaths per year

This is of course quite different from the claims of the industry, and from "evidence" of poorly designed studies which the industry claims back its estimates. It should be remembered that these numbers arc radiation initiated fatal cancers which may take years to develop and to be diagnosed. By the time all of the cancers arc "seen" the nuclear facility will be moth-balled and the operators gone.

Annual Limits of lntake

The nuclear industry routinely emits radioactive chemicals into the air or water in the vicinity of a plant. It is difficult to regulate a mixture which is ever changing, so these radioactive chemicals are regulated one at a time as if the total permissible dose for the year was obtained from one radioactive chemical and via one pathway. Assuming that the Standard Man (a twenty year old Caucasian male in good health) has a standard breathing rate and inhalation and drinks a fixed amount of water every day, these estimates are converted into maximum permissible concentrations of the radioactive chemical in air or water. The concentration permitted would give the Standard Man the maximum permissible dose in one year. These number can be modified for Asians, for women or children, for various combinations of radioactive chemicals etc. These are the derived limits for cumulative releases from nuclear reactors. However, inhaled or ingested radioactive chemicals also pose special problems. They often arc dispersed differently in the body. For example radioactive iodine concentrates in the thyroid glass and cacsium in muscle.

Recently the ICRP has invented the Cumulative Effective Whole Body Dose, which accumulates the dose expected from the radioactive chemical over the next fifty years of the person's life the organs affected, and the whole body dose which would cause the same number of fatal cancers. This methodology seriously neglects non-fatal cancers. For example only 5% of thyroid cancers and less than 1% of skin cancers are considered fatal. These non-fatal cancers are allowed under the radiation protection schema.

For every 20 fatal cancers caused by radiation, about 10 non-fatal no-skin cancers and 20 skin cancers will be caused. It is certainly not clear that these non-fatal cancers should be ignored when "protecting" people from radiation!

This puts the nuclear industry in an even higher risk category when its permissible exposure levels are attained. It is assumed that 100 cancers will be caused per 10,000 workers per year, 40 of which are expected to be fatal. For the general public it means 500 cancers per million people per year, 200 of which arc expected to be fatal

As pointed out earlier, this does not include the other more frequent effects of exposure judged by the nuclear experts to be of no concern to people. These include autoimmune diseases and depressed cellular immune system. The latter leaves the person vulnerable to the more serious viral and bacterial infections and less able to cope with cancers caused by other factors.

A *New Approach to Radiation Research*

When the radiation exposure level is low, i.e. within an order of magnitude of natural background radiation, I believe that it is best understood as contributing to the effects of that background radiation. Over time the human body "ages". Ordinary diseases come more frequently and last longer. The ability to overcome fatigue and illness is lessened Cancers and autoimmune disease incidence rate increases. Not all of the characteristics of old age arc connected with background radiation, but certainly some arc. Chronological age is a good measure of cumulative background exposure to ionising radiation.

The acceleration of some of the components of ageing can explain a part of the problems experienced by those exposed to radiation, for example, the earlier occurrence of breast cancer in young women under age ten at the atomic bombings, and the adult illnesses observed in Chernobyl children. It can open new ways to understand the subtle chronic exposures which accumulate over a lifetime and finally lead to death because of our inability to deal with our environment. The natural process can apparently be accelerated by increasing radiation exposure levels.

Some phenomena arc not repeatable, and radiation exposure becomes redundant, or useless for producing that effect. An illness like adult onset diabetes for example, is an old age disease which one cannot acquire more than once. Therefore, one can expect lessening of the effect of radiation on ageing as the cumulative dose increases. However, at higher doses, direct damage to vital organs and direct induction of cancer can be expected to increase. I believe that there arc complicated and competing effects of radiation, the ageing effect being predominant at the low doses.

Can the ICRP be trusted to set radiation protection standards?

The obvious answer is no. I think that it is time to disassociate ourselves from this self-appointed recommending body. Firstly, it docs not have as its goal, protection of worker and public health. Rather, its goal is to recommend the "acceptable" trade-off of that health for the benefits of nuclear industries (medical, commercial and military) which it represents. In the fifty years since the formation of the ICRP it has never taken a stand on behalf of worker or public health, even against such obvious violations of human rights as non-ventilation of underground uranium mines and nuclear atmospheric testing.

It is also possible to fault the ICRP for its non-democratic structure. It is a self-appointed and self-perpetuating non-gove r nme n t al organisation. Its behaviour does not follow that of usual scientific bodies.

The ICRP, moreover avoids all responsibility for its recommendations. It claims that it merely makes recommendations, which then become the responsibility of individual nations to either implement or modify as they see fit. However, it is evident that most nations lack the financial and scientific capacity to counter the unlimited resources and international prestige of the ICRP. Politicians and bureaucrats, with low scientific literacy, take the easy way out and adopt these international recommendations.

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