1.The health effects of low dose radiation; Mechanisms and Evidence

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2. Summary of argument

- Childhood and adult cancer is caused by human internal low-dose exposure to novel man-made radioactive isotopes e.g. Sr-90, Pu-239 and novel forms of natural isotopes, e.g. Uranium weapons
- Error in ICRP risk model for internal irradiation is due to averaging of doses over large tissue masses instead of examining the dose to the individual cell.
- The nuclear site (e.g.Sellafield, La Hague, Dounreay) leukemia clusters require error in ICRP model of 300-1000 fold.
- Increases in infant leukemia after Chernobyl demonstrate error of 100-500 in ICRP risk models.
- Consequences for children and adults exposed to internal radioactive contamination are seen in the present cancer epidemic and other effects. e.g. Irish Sea, Chernobyl, Depleted Uranium, etc.

Notes: The reality is that the nuclear project has caused the deaths of millions of people as a result of the exposure to man-made fission products. There is epidemiological evidence that this is so, but it has been ignored or suppressed because the ICRP risk factors are based on models involving external acute radiation exposure to the Hiroshima survivors. I will argue that these models are wrong because the internal exposures are qualitatively different from the acute external exposures.

3. Errors in conventional (ICRP) risk model

- External vs. internal
- Natural vs. man-made
- New forms (e.g. hot particles)

Result is failure by government and international agencies (IAEA, WHO, ICRP. UNSCEAR, EU) to protect public from serious ill health and death.

Note: The errors in the ICRP model arise from failure to see that there are differences in the cell doses from internal and external irradiation, between some man made and all natural isotopes and because of the existence of new types of exposure to particles.

4. ICRP phantom

Note: This is the way in which ICRP assess radiation dose to humans. For external radiation all cells get the same number of tracks, This is not so for internal isotopes and hot particles.

Depleted uranium particle doses

This table shows the doses to tissue volumes within range of the alpha decays from a DU particle.

Main areas of interest

- Mechanism (reasons why risk model is wrong at cell level).
- Epidemiology (evidence that model is wrong from studies of those exposed).
- Politics (evidence of control of scientific research, control of data, dishonesty and cover-up of effects through 'science committees'.
- The way ahead (alternative institutions)

Note: \these are the areas I will briefly examine.

5. Mechanistic errors

- **Anisotropy in space**

For internal isotopes and particles a cell may receive a very much higher dose than the average tissue dose (eating hot coals). This applies to isotopes which bind to DNA, to Auger emitters and hot particles. Response in this region is proportional to the square of the dose.

- **Anisotropy in time**

A cell may receive more than one track delivered sequentially in a way that causes it t o try and repair the initial damage and then get hit during a sensitive phase of the repair. This is the Second Event Theory.

- **Genomic instability, byestander doses and cell communication communities**

New research shows that if a cell is hit, its progeny are likely to suffer from an increased tendency to general mutation. This is called genomic instability.

But in addition about 30% of all cells in a local cell community (about 400 cells radius) also suffer genomic instability due to a signal from the damaged cell. This is the byestander effect. Taken together, these discoveries show that cell communities are important units in the development of cancer. Therefore the presence of many tracks from internal hot particles (PU, U) to such a community represents a significant process for the development of cancer. Both effects show highest response at low dose.

Dose response is supralinear or biphasic, as shown by chromosome aberration and other end points.

6. Variation in cell response to radiation over its cell cycle

Note: Cells have a very wide range of sensitivity over their lifespan. If replicating, cells can be hundreds of times more sensitive. Cells can be induced to replicate by exposure to radiation or chemicals. This is the basis of the Second Event Theory where two sequential tracks can cause higher risk of mutation.

7. Hot particles
In Sellafield
Irish Sea coast
mud core
(autoradiograph)

8. Hot particles
In edible mussel
From Irish Sea
(CR39 method)
Specks show
Alpha
decay tracks

9. Local doses from Plutonium Particles

10. Epidemiology

- Infant mortality after weapons fallout (Sternglass, Whyte, Busby, Koerblein).
- Cancer epidemic shows earlier onset and highest magnitude in high rainfall countries. In Wales correlates with cumulative Sr90 doses.
- Nuclear site child leukemia and cancer clusters (Sellafield, Dounreay, La Hague, Aldermaston discovered in the period 1983-1996. Causality denied by ICRP, COMARE, UNSCEAR, BEIR, WHO, EU and Nuclear Industry. Reay and Hope Court Case lost after death of Martin Gardner and focus on PPI.
- Chernobyl accident focused attention on health effects, particularly Thyroid cancer and leukemia. Covered up by Soviet authorities and IAEA/UNSCEAR.

More recently evidence slowly emerging of massive health detriments in affected territories.

- Discovery of cancer near contaminated sea coasts especially Irish sea and Severn Estuary and Bradwell (UK) implicates particles (Busby, Dorfman, Bramhall et al 1998-2004)
- Discovery of increase in infant leukemia after Chernobyl in 5 separate countries shows unequivocally the error in ICRP of 100-500 fold in risk factors. (Busby and Scott Cato, 2000)
- Minisatellite mutations in Chernobyl exposed groups give objective measure of harm (Dubrova, Weinberg)
- DU effects in Gulf and Kosovo veterans, in Iraqi children and adults.

11. Politics of Science

- Prime strategy for anti-nuclear movement in 1992 was to attack the scientific basis of risk modelling: thus using existing laws to cut off their permissions to operate and persuade the public that discharges are causing harm.
- This required two approaches, analysing the science and then developing a credible base for criticising it. These were Green Audit and the Low Level Radiation Campaign
- By 2001, Green Audit and the Low Level Radiation Campaign, Chris Busby, Richard Bramhall and Molly Scott Cato with help from many friends and some foundations had achieved the basis for this in the development of a number of new institutions, notably:
- The European Committee on Radiation Risk www.euradcom.org whose report ECRR2003 has now been translated into Japanese and French.
- The UK government Committee Examining Radiation Risk from Internal Emitters www.cerrie.org set up by Michael Meacher in 2001 following meetings with Green Audit and LLRC due to report in September will find that the ICRP model is invalid for internal radiation.
- The UK Ministry of Defence Depleted Uranium Oversight Board www.duob.org

12. This has taught us the best strategy for the Green Movement faced with the scientific arguments for industrial growth

This strategy is:

Create alternative institutions