

## **Radiation and the Sellafield autopsy tissues**

This is a referenced edition of the article published in *Radioactive Times* Vol 7 No.2 April 2008 pp 11-13 (<http://www.llrc.org/rat/subrat/rat72.pdf>)

In an emergency statement in Parliament on 18<sup>th</sup> April 2007 Trade and Industry Secretary Alistair Darling announced that Mr. Michael Redfern would be heading an inquiry into nuclear workers' body parts being taken without the consent of relatives. Behind this lies an older, greater scandal.

As early as 1959<sup>1</sup>, when the first orgy of testing nuclear bombs above ground was over and the second was about to begin, autopsy tissues from hundreds of members of the public were being analysed for their radioactive content. This happened in many countries, including Britain, and went on into the 1980s.

In 1983 Yorkshire TV's documentary *Windscale the Nuclear Laundry* revealed a cluster of childhood leukaemia in Seascale, next door to Britain's Sellafield plant. The political fallout was so great that the Government immediately set up an investigative committee under Sir Douglas Black. It met within three weeks of the YTV transmission and reported within a year. It suggested, among other things, that autopsy tissues would be a useful place to look for evidence. The committee was particularly interested in tracheobronchial lymph nodes, as they were known to store radioactive particles and were also implicated in the origin of leukaemia and lymphoma.<sup>2</sup>

### **Coroners and coronaries**

Pathologists acting in coroners' inquests began supplying Britain's National Radiological Protection Board (NRPB) with livers, lungs, tracheobronchial lymph nodes, ribs, femurs and vertebrae. The 62 "donors" were from central Scotland, Oxfordshire, north-east England and west Cumbria. They died between 1981 and 1985, mostly from cardiovascular disease. Most were over 50. A small number of younger people including teenagers were also selected. The intention was to exclude people who had worked in the nuclear industry but in Cumbria a few ex-BNFL employees slipped through the net with interesting results, as we shall see.

The tissues were destroyed by the analytical process, which involved ashing them in a furnace for several days at temperatures up to 500<sup>0</sup>C, followed by boiling in acid.

### **Is Sellafield leaking Plutonium?**

NRPB published its first results in 1985.<sup>3</sup> The study had two stated aims. One was to build upon earlier investigations of how much Plutonium nuclear workers were getting into their bodies in the work place; NRPB said it *would be more enlightening* if the worker's body burdens were compared with the general public who could be assumed to have got their Plutonium from weapons test fallout. The second aim, showing the influence of the Black Report, was to compare the Cumbrian public with other parts of Britain to see whether Sellafield was leaking. NRPB warned that this aspect might be tricky because Cumbria could be expected to have more weapons test fallout than regions with lower rainfall.

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<sup>1</sup> Osborne R.V. 1963 Plutonium 239 and other nuclides in ground level air and human lungs during spring 1962 *Nature* 199, 143. Table 1 in NRPB's 1985 paper has deaths as early as 1959.

<sup>2</sup> According to the 4<sup>th</sup> Report of COMARE March 1996 page 74.

<sup>3</sup> D. S. Popplewell et al. Plutonium in Autopsy Tissues in Great Britain *Health Physics* 49 No. 2 304-309

### **Cumbria — a radioactive environment**

In the event, the difference was greater than could be explained by high rainfall. Human bones from Cumbria contained, on average, 1.7 times as much Plutonium as bones from the other regions. The livers had twice as much, the lungs more than 3 times, and the tracheobronchial lymph nodes 3.25 times.

### **The cover-up**

Coming so soon after the YTV revelations these high values were embarrassing and within a few months NRPB published a new version.<sup>4</sup> This was a summary, but it confusingly and quite inexplicably introduced three new cases which had no business being in the study at all, since they were ex-Sellafield workers who had been included by mistake. In the context of discussing the remarkably high body burdens of Plutonium (the Sellafield 3 contained, on average, 138 times as much Plutonium as their Cumbrian neighbours) the new report also raised the issue of Plutonium ratios.

### **Plutonium ratios — fingerprinting the suspects**

The three most important isotopes of Plutonium are Plutonium 238, 239 and 240. Plutonium 238 (<sup>238</sup>Pu) is the one that matters here. It's created by neutron bombardment of Uranium 238 in a reactor or in the explosion of a nuclear bomb. A reactor makes more <sup>238</sup>Pu than a bomb does and this means environmental samples can tell us whether the Plutonium came from industrial discharges or weapons test fallout. In industrial samples around 25% of the Plutonium present will be <sup>238</sup>Pu; in weapons fallout it is between 3% and 8%.

The technique NRPB used to examine the British autopsy tissues was capable of reading the fingerprint. It was quality tested at the outset, using Standard Reference Material from the US National Bureau of Standards in the form of freeze dried human liver. NRPB's test run agreed closely with the Standard Reference <sup>238</sup>Pu content.

### **Fudging the fingerprints from the first ...**

NRPB's first paper (in 1985) has no data on the Plutonium ratios. This is odd, considering what they set out to discover. The 1986 update tells us that although there are *ample data showing that the ratio is as high as 25% in sea-borne material reaching crops, animals and soils along the Cumbrian coast* (in other words, it came from Sellafield) there are no data on Plutonium ratios in the Cumbrian public; there is only the unsupported assertion that *In the autopsy tissues where it has been possible to measure isotopic ratios, the values have approximated in general to fallout value, including values from Cumbrian non-occupationally exposed cases.*

Two years later the final version of the study<sup>5</sup> concluded

*... the slightly higher concentration [...] in non-occupationally exposed Cumbrians [...] is unexplained. The higher rainfall could be the reason.*

### **... to the last**

Lets be clear about the context for all this and what NRPB was asking the public to believe. Maybe, in the last 20 years, we've grown accustomed to knowing that

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<sup>4</sup> Radiological Protection Bulletin No. 74 July 1986 pp. 10-12

<sup>5</sup> Plutonium and Cs-137 in autopsy tissues in Great Britain D.S. Popplewell et al *The Science of the Total Environment* 70, (1988) 321-334

Sellafield has massively polluted the marine environment and that the radioactivity is coming back onshore (the national news media certainly have got used to it) but it was a public relations problem in the years after the shock of the Seascale childhood leukaemia cluster. So the official imperative was to conceal Sellafield's impact on human health, and NRPB's aim was to show that, although they couldn't deny the industrial origin of the Plutonium pounding onto the Cumbrian coast, none of it was making its way into local livers and lymph nodes. If it wasn't Sellafield that was contaminating the people, then what was? Nuclear weapons were the only candidate. Above-ground testing had ended twenty years earlier, so it was politically safe to blame that for public body burdens of Plutonium — after all, only a few of the bombs were British. Is this a credible explanation?

### **Official figures finger Sellafield**

*Radioactivity in Food and the Environment* has been published by various Departments since the mid-1990s, with information on many terrestrial and marine samples. The Plutonium fingerprint can be worked out. Just divide the total for  $^{239+240}\text{Pu}$  into the figure for  $^{238}\text{Pu}$  (multiply by 100 to get it as a percentage). In general the samples show the presence of Plutonium from a reactor. It's what you'd expect, because this monitoring is focussed on nuclear sites. The point is that fish, fish meal, molluscs, seaweed, fruit, vegetables, eggs, wild animals and farm animals all show the same fingerprint ratios as their surroundings. In the 1996 edition of *RIFE*, 20% to 25% of the Plutonium in cow and sheep livers on farms round Sellafield and the nearby Ravenglass estuary was  $^{238}\text{Pu}$ .<sup>6</sup> More recent data from 2004<sup>7</sup> shows bovine liver up to 29%, and in 2005<sup>8</sup> sheep "offal" was 18%  $^{238}\text{Pu}$ . So if these terrestrial vertebrates obviously take up Sellafield's Plutonium why should we believe that human livers somehow reject it but can't avoid taking up Plutonium from weapons fallout, especially when the assertion is supported by no data?

### **The mystery of the Sellafield 3 – exculpating their employers**

We are left with the puzzle of why NRPB wrote the three ex-Sellafield workers into the second and third studies. Maybe it was because from May to July 1986 (when the second was published) NRPB staff were so distracted by the arrival of fallout from Chernobyl that they forgot they were about to publish embarrassing information. First, their new data announced how much Plutonium contamination a nuclear worker might suffer; the livers contained 6 to 18 times as much Plutonium as members of the public in Cumbria; their bones contained between 10 and 60 times as much; the lungs 17 to 160 times as much. Secondly, the figures for the lymph nodes confirm, to a greater degree even than the data published the previous year, that lymph nodes have a vast capacity to store Plutonium. The lymph nodes of the least contaminated worker were 41 times the Cumbrian average, the hottest was nearly 2000 times the Cumbrian average and over 7000 times the average for the other regions. This showed Sir Douglas Black's committee was right to worry. The lymph node data are missing from the final report.

If there was any logic behind including the Sellafield 3 it was to mislead a hasty reader about the Plutonium fingerprint. The ratios in the workers are low — between

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<sup>6</sup> RIFE 1 (1996) page 79 Ravenglass bovine liver 24%  $^{238}\text{Pu}$ ; sheep kidney or liver 20%. Ibid page 75 Sellafield sheep kidney or liver 25%.

<sup>7</sup> RIFE 10 (2004) page 88

<sup>8</sup> RIFE 11(2005) p. 75

2% and 9% <sup>238</sup>Pu. The wording of the report is unscientifically vague; NRPB did not explicitly conclude that the workers' Plutonium came from weapons tests, but in the same paragraph they did they conclude fallout caused the contamination found in the members of the public. Remember that they gave no data to support this. So NRPB were on their usual agenda of keeping us confused so that Sellafield wouldn't be embarrassed. One thing we can be glad of; apart from the airbrushing, the study was more or less closed before the Chernobyl disaster. Otherwise NRPB would not have floated bomb test fallout as an alibi — they'd have leapt on Chernobyl like a bank robber embracing a bishop.

### **Darling's chance to be open**

As for the new scandal, Members of Parliament debating Alistair Darling's emergency announcement in April 2007 piously hoped that the Redfern inquiry might elicit some good information about radioactivity and health. It is hard to see how it could. A lot of time has elapsed, the sample was small (65 people), and there are certain to be confidentiality issues and data loss.

The one ray of hope is Mr. Darling's commitment to openness in the industry, which he re-emphasised in the debate.<sup>9</sup> We need some information. The magazine *UKAEA Today* routinely contains obituaries of UKAEA employees. LLRC's scientific advisers Green Audit have looked at well over 2000 of them, finding a significant difference in the mean age of death between sites with low and high levels of ground contamination.<sup>10</sup> It seems that working on dirty sites reduces life expectancy by five years compared with the less contaminated. Green Audit's result is in line with the anomalous Standardised Mortality Ratios (SMRs) calculated, but not explained, by the second study of the National Registry of Radiation Workers in 1999. However, the age structure of the workforce is not known, so Green Audit has not been able to calculate SMRs and complete the study ready for publication. Herein lies the opportunity. We asked Mr. Darling to require British Nuclear Group to provide a breakdown of the workforce by five-year age group for each of its sites between 1970 and 1980. He did not reply. We have written to his successor, John Hutton, to ask again. [Reviewing this article in November 2010, on the day Michael Redfern's report into the Sellafield autopsy tissues is released, LLRC notes that Hutton, also, never replied.]

### **Postscript**

A few final points (bear in mind this paper was written in 2008).

- The number of people investigated in the three NRPB studies seems to have been 62 — remarkably close to the 65 mentioned by Alistair Darling. We hope Mr. Redfern isn't going to be confused about the general public's and the workers' studies. We're making contact with him.
- The 1986 report cited a legal problem with obtaining tissues to analyse. Professor Bernard Knight, in his 1985 paper *Legal Considerations in the Retention of Post-mortem Material*, had advised that retaining tissue for teaching and research was not covered by a Coroner's authority, and authority

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<sup>9</sup> **18 Apr 2007 : Column 307. Mr. Darling:** "[...] I have said on numerous occasions that the industry could help itself enormously by being open. If there are problems, let us discuss them. If things went on the past, let us hear about them—subject, of course, to observing sensitivities and the confidentiality to which families are entitled. It is far better to be open about these things."

<sup>10</sup> Powerpoint slides which illustrated a recent presentation of this evidence are online at [http://www.ciria.org/safegrounds/pdf/conference\\_07\\_risk.pdf](http://www.ciria.org/safegrounds/pdf/conference_07_risk.pdf)

for such purposes could not be granted by the Coroner.<sup>11</sup> It looks as if NRPB's samples were obtained illegally and that Professor Knight's advice may have put a stop to the flow of body parts. [Reviewing this article in November 2010, LLRC observes that Energy Minister Chris Huhne's declaration that autopsy tissues are no longer retained is about 25 years out of date.]

- Notwithstanding Professor Knight's opinion, the third NRPB study [July 1986] ends by announcing that, in line with the Black report, they had begun measuring Plutonium in autopsy tissues from young children. We're looking into this. [Actually we haven't.]
- NRPB never had any intention of using the autopsy data to learn anything about radioactivity and health; diseased tissues were excluded from the study.
- COMARE, preparing its 1996 report on the Seascale cluster, sparked off a further NRPB cover-up of the influence of tracheobronchial lymph nodes on health. They asked NRPB to work out the Plutonium doses to the lymph nodes. In an unreviewed and unpublished back-of-envelope sum NRPB overestimated the mass of the lymph system by 550 times, thus diluting the doses to insignificance. COMARE hadn't the wit to see this for themselves. The struggle to drag this into the light is described in *Wolves of Water* (pp 283-5)<sup>12</sup>.
- The Redfern inquiry is expected to take a year from its inception in April. [Actually it's taken three and a half.]

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Text of letter 26<sup>th</sup> April 2007  
Low Level Radiation Campaign to  
Alistair Darling  
Secretary of State for Trade and Industry  
"Dear Mr. Darling,

Nuclear industry post mortems

During discussion of your statement in the House on 18<sup>th</sup> April several members expressed a wish for some dependable information about radiation and health to emerge from recent revelations about nuclear industry workers and tissue samples. You also heard a call for the nuclear industry to behave with greater openness than in the past and you took the opportunity to confirm your commitment to that.

As Mr. Redfern is sure to find out quite quickly, nuclear industry employees were not the only people to have had their tissues tested post mortem. In 1983 the NRPB made data available to Sir Douglas Black's investigation of the Seascale childhood leukaemia cluster. Black's Independent Advisory Group said (para. 4.69) that *post mortem assessments of tissue levels would be a possible source of information on human exposure* and in the next few years a number of published studies gave details of the Plutonium content of hundreds of samples taken *post mortem* from members of the public.<sup>13,14,15</sup> [These are refs 1,2,3 in the Darling letter]. Maybe you will think it

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<sup>11</sup> and see [http://www.bristol-inquiry.org.uk/interim\\_report/annexb2.htm#57](http://www.bristol-inquiry.org.uk/interim_report/annexb2.htm#57)

<sup>12</sup> <http://www.llrc.org/wings/subtopic/wolves.htm>

<sup>13</sup> D. S. Popplewell et al. Plutonium in Autopsy Tissues in Great Britain *Health Physics* **49** No. 2 304-309; Plutonium and Cs-137 in autopsy tissues in Great Britain; D.S. Popplewell et al *The Science of the Total Environment* **70**, (1988) 321-334

<sup>14</sup> Radiological Protection Bulletin No. 74 July 1986 pp. 10-12

<sup>15</sup> D.S. Popplewell et al *The Science of the Total Environment* **70**, (1988) 321-334

prudent to define Mr. Redfern's terms of reference to include the question of whether family consent for this work was sought or obtained.

It is unlikely that any information that can be gleaned from the post mortem data will be helpful on links between radioactive pollution and disease. The reasons are too complex to explore in detail here; they concern the small sample, the time elapsed and issues of confidentiality. If the workers' studies followed the same protocol as NRPB's studies of members of the general public, any organs associated with the cause of death will have been excluded. These factors will be exacerbated by the radiation risk agencies' obsession with averaged absorbed dose as the key quantity in assessing exposures and the Japanese A-bomb data as the basis of risk estimates which, as in the case of the Seascale cluster, would lead to the routine claim that doses were too small to have caused the diseases in question. You may not be aware that these assumptions are severely compromised by recent developments in radiation protection or that DoH list of radiation protection research priorities reveals a profound ignorance of the mechanisms of harm and the degree to which radioactive contamination internal to the body threatens health. This is a complex area. We can advise you on it, if you require. You should beware of the prejudices of your officials.

The present crisis gives you a chance to elicit some useful information about radiation and health and simultaneously to increase public confidence in your openness agenda. We refer you to an unpublished study by Green Audit which was previewed at the SAFEGROUNDS conference in London in March. Using over 2000 obituaries of UKAEA employees published in the *UKAEA Today* magazine, Green Audit tabulated the employees' ages at death. There was a significant difference in the mean age of death between sites with low and high levels of ground contamination.<sup>16</sup> [Ref 4 in the Darling letter]. The data strongly suggest that working on the more highly contaminated sites reduces life expectancy by five years compared with the less contaminated. This use of a control group internal to the industry avoids comparisons with the general population and the fraught question of the healthy worker effect. It is also noteworthy that Green Audit's result is in line with the anomalous Standardised Mortality Ratios (SMRs) calculated, but not explained, by the second study of the National Registry of Radiation Workers. Green Audit however has not been able to calculate SMRs since the age structure of the workforce is not known, and for this same reason has not been able to complete the obituaries study and submit it for publication. Herein lies your opportunity. Please request British Nuclear Group to provide a breakdown of the workforce by five-year age group for each of its sites between 1970 and 1980.

For your information I enclose the draft of an article intended for publication. It describes the studies of autopsy tissues take from members of the public in some depth. Please pass on this material to Mr Redfern.

Yours sincerely

Richard Bramhall

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<sup>16</sup> The Powerpoint slides accompanying the presentation are online at [http://www.ciria.org/safegrounds/pdf/conference\\_07\\_risk.pdf](http://www.ciria.org/safegrounds/pdf/conference_07_risk.pdf)

PS Please note that there is a typographical error in the table on page 15 of the Powerpoint. The last cell ought to read 79. The figures in round brackets in the last column of that table are Standard Deviations in years."