The Scientists Who Alerted Us to the Dangers of Radiation

By

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"Salus populi supremo lex esto."
*(*The health and safety of the people is the supreme law.*)*
Cicero (106 - 43 BC)

"The release of atomic power has changed everything except our way of thinking...
.... the solution to this problem lies in the heart of mankind."
Albert Einstein (1879 – 1955)

"Radiation, in its simplest terms - figuratively, literally and chemically - is poison.... there is no amount of radiation so small that it has no ill effects at all on anybody. There is actually no such thing as a minimum permissible dose. Perhaps we are talking about only a very small number of individual tragedies - the number of atomic age children with cancer, the new victims of leukemia, the damage to skin tissues here and reproductive systems there - perhaps these are too small to measure with statistics. But they nevertheless loom very large indeed in human and moral terms."
US President John F. Kennedy (1917-1963)[*]

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[*] https://www.jfklibrary.org/archives/other-resources/john-f-kennedy-speeches/milwaukee-wi-19600402-wisconsin-assoc-of-student-councils

Preface

The history of radiation risks - in particular scientists' perceptions of these risks in Europe and North America - reveals they have been argued about ever since radiation and radioactivity were discovered at the end of the 19th century.

It also reveals they have consistently been underestimated.

Even today, radiation risks remain a battleground of scientific opinions, values and politics. Broadly speaking, a gulf has existed and still exists between official radiation risks published in government and industry reports and the risks observed and/or estimated by many distinguished scientists.

These scientists had found evidence that radiation risks, including cancers and birth defects, were greater than official estimates, but they and their scientific reports were often adversely treated by officialdom both in the West and the East. These scientists consequently suffered career blight, cessation of funding, seizure of their data, peer group ostracism, plus public criticism and opprobrium.

The rub of the matter is that, from recent findings, we now know beyond doubt that these scientists were correct.

Many of these scientists are no longer with us: a main aim of the book is to remember and commemorate them.

The book does not describe the nuclear engineers, nuclear regulators and researchers at environmental NGOs who have alerted the public to nuclear industry malpractices and government misdeeds - albeit not necessarily on radiation risks. It also does not include non-scientists such as Karen Silkwood (US) and Hilda Murrell (UK) killed in suspicious nuclear-related circumstances in 1974 and 1984 respectively. And it cannot describe the many victims of nuclear accidents nor the many nuclear veterans exposed during bomb tests since the start of the atomic age. To have included them would have made the book too long. They are properly the subjects of books yet to be written.

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Introduction and Authors' Statements

Chapter 1
Introductory Remarks

The history of radiation[1] risks - in particular the perceptions of these risks in Europe and North America - reveals a long-running battle of scientific interpretations, values and politics. This phenomenon was commented upon for example by Wing et al in 1997 who stated

> *"Although controversies over scientific findings are common, the topic of health effects of ionizing radiation has generated an exceptional amount of heat. Despite a century of research since Roentgen's discovery of X rays, fundamental disagreements exist over biophysical mechanisms, dose-response assumptions, analytical strategies, interspecies extrapolations, and the representativeness of studies of select human populations."* (Wing et al, 1997) (references at end of each chapter)

Broadly speaking, a wide gulf has existed - and often still does - between official radiation risks used in government and industry reports and the risks actually observed by the scientists discussed in this book. These scientists found evidence that radiation risks, including cancers and birth defects, were greater than official estimates, but they and their scientific reports were often harshly treated by officialdom when they tried to publicise, or even report, their findings.

As many of these scientists are no longer with us, a main aim of the book is to remember and commemorate them, in particular those scientists who suffered official displeasure and/or public criticism or opprobrium as a result.

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[1] This book is about ionising radiation - defined as having sufficient energy to eject electrons from parent atoms - and is distinguished from non-ionising radiation. A background note on radiation's hazards and risks is contained in Appendix K.

Recent evidence and understandings of radiation's effects clearly show that these dissenting scientists were, in fact, right and that official attitudes were and are incorrect. This evidence is shown early in this book - in Part B.

However first it is necessary to discuss some scene-setting matters. These include our statements on ethics, institutional bias, confirmation bias, the ethics of corporate bodies, and our own attitudes on radiation risks and on nuclear power.

These are contentious subjects as we shall see, but it is necessary to discuss them so that readers can be clear where we are coming from and can make their own value judgments about our approaches to radiation risks.

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Statement on Ethics

The defence of dissenting scientists necessarily involves ethics - defined as the moral principles governing a person's beliefs and conduct. Professor Robert Proctor, in his book Cancer Wars (Proctor, 1995) has stated that, in the area of radiation risks "….*action must root itself in an ethical vision*." (page 171)

We agree and are writing this book because it remains unfair and ethically questionable for official bodies to have discredited scientists for their views on radiation risks, especially when it turns out later that these scientists were correct.

While it is normal for scientists to query the findings of other scientists, this book will show that, in too many cases, this opposition took a sinister turn and resulted in severe discrimination and often public disapprobation.

As we are critical of others' ethics, it's necessary for us to state what our own ethical vision is. Like most people, we have a mixed bag of ideas and values, but our ethical principles include -

(a) fairness and equity towards environmental scientists - even if (and especially if) they disagree about the scientific evidence promulgated by official bodies.

(b) freedom of expression. In her book The Friends of Voltaire, as an illustration of Voltaire's beliefs, author Evelyn Beatrice Hall (1868 –1956) wrote

"I disapprove of what you say, but I will defend to the death your right to say it".

However this principle is not unfettered: it does not extend for example to hate crimes or the promotion of unlawful or harmful activities. It is always associated with the responsibility to ensure that what we say does not harm others.

(c) the need to protect the public, or at least act in the interests of the public. This value is enshrined in the famous dictum of Cicero, Roman consul and statesman of the first century BC, who stated "*Salus populi supremo lex esto*": the health and safety of the people is the supreme law. This pronouncement is found engraved on many law courts and public buildings around the world, including the Old Bailey in London UK, and the Capitol buildings of many US States. We are guided by Cicero's dictum in this book.

(d) the precautionary principle. This requires caution whenever danger is known to exist but not its probability or risk. Whenever science finds a plausible risk, this principle implies a social responsibility to protect the public from exposure to harm. The principle first emerged during the 1970s and has been enshrined in international treaties on the environment, including the Maastricht Treaty on the Functioning of the European Union and in the national legislations of several countries. Unfortunately, this principle is the subject of polarised views. To some, it is unscientific and an obstacle to economic progress. To others, it is a normative approach that protects human health and the environment. We count ourselves among the latter group.

(e) finally, an overarching principle is the golden rule, i.e. doing unto others as one would be done by. It is clear from most of the case studies in this book that official scientists often did not do this: the golden rule has often been more honoured in its breach than its observance. But this principle lies at the core of our approach to this book.

Institutional Context

In a lengthy letter published in the correspondence section of the journal Environmental Health Perspectives, Wing, Richardson and Armstrong made several thoughtful comments about how radiation risks are perceived in the scientific community. They argued (Wing et al, 1997) that scientific research (including on radiation risks) usually takes place <u>within an institutional context</u> which affects the framing of questions and the interpretation of evidence. The institutional context included prevailing professional opinions, judgments and the denial of views not emanating from professional channels.

The authors added that recognition of the connection between knowledge and its institutional context challenges the conventional view that objectivity requires the removal of all extraneous influences. Instead a more nuanced view requires authors to seek objectivity through (a) explanation of their assumptions and values and (b) avoidance of bias in study design, data collection, and analysis (see Harding, 1991).

We agree with these views.

Confirmation Bias

With scientific studies, another problem is confirmation bias - defined as conscious or unconscious attitudes which make authors' conclusions less reliable. This could occur for example when authors look for information or patterns in scientific articles that confirm ideas or opinions already held by them.

At the outset, it is admitted that there is no such thing as completely bias-free interpretation in science, and personal views are often strongly held. For example, Latour and Woolgar (1986, p. 243) considered that science is often *"…a fierce fight to construct reality."*

In our view, the best that can be done is (a) steer an ethical course by relying on the most rigorous scientific studies available, adhering closely to their evidence and (b) be transparent about one's own bias or biases. With that in mind, this book is written from a public health point of view.

This book will present evidence that, especially in the past, many official scientists in the nuclear establishment[2] remained relatively unconcerned about radiation risks. Initially, radiation scientists were often more concerned with the rush to make nuclear weapons and later with Cold War imperatives than health and safety considerations. But later, many were concerned about possible damage to the reputation and future prospects of nuclear power or nuclear weapons or medical procedures than damage to humans and the environment. (See time line at Annex F.)

[2] "Nuclear establishment" is defined as including government energy departments (eg the US DOE), government defence departments, nuclear weapons facilities (of which about dozen exist in the US), nuclear research laboratories, nuclear power research bodies, nuclear regulatory agencies, nuclear industry associations, and various radiation protection bodies including the US NCRP, IAEA, UNSCEAR, WHO, ICRP, and the OECD-NEA.

These attitudes were often due to mindsets among radiation scientists that the risks of low levels of radiation were low and could be safely neglected. But it is clear that, at least to some degree, the lack of concern about the effects of radiation seems to be rooted in nuclear establishments themselves. For example, we show in Appendix D that, in another area of toxicity i.e. chemicals, better health standards exist which, by and large, protect the public better than present radiation standards do.

Confirmation bias is partly why most publishers of science reports require authors to reveal their sources of funding and to state possible conflicts of interest. In our view, this is not enough: authors should also be required to acknowledge their possible biases including, for example, all past employments, tenureships, society memberships, and the holding of strong beliefs which may affect their conclusions.

Ethics during Radiation Risk-Setting

Relatively few academics have studied the ethics of radiation risks, including those of risk-setting organisations. One academic who has is Emerita Professor Shrader-Frechette (q.v.) who has argued that ethics should be involved here. During an IAEA Conference (IAEA, 1994) she stated that, when standards were being decided on radiation risks, ethics were just as important as risk magnitude. She stated that risk assessments on radiation should

a. include democratic preferences
b. include citizen negotiations
c. include the examination of alternatives
d. limit false negatives (eg in statistical tests)
e. protect the most vulnerable people in situations of uncertainty
f. not presuppose zero values for small threats to health and safety, and
g. include equitable risk distribution, compensation and consent in any trade-offs on radiation risks.

This book agrees with Professor Shrader-Frechette that these matters should be included, but often in the past they were not. Even today, it is rare to see these ethical matters addressed in studies on radiation risks.

On a separate but related matter, this book also asks to what degree publicly-funded organisations on radiation protection actually operate in the public interest. When it comes to radiation risks, several official bodies - ostensibly responsible for protecting the public - do not appear to do so. This is discussed in Appendix B.

Nuclear Power

Also at the start, we need to discuss nuclear power as attitudes to radiation risks are often connected to attitudes on nuclear power and nuclear weapons. It is widely noticeable for example, that advocates of nuclear power often consider radiation risks to be overstated. Even today, it is common for officially-funded scientists and officials in government nuclear agencies and regulatory bodies to have favourable attitudes to nuclear power and nuclear weapons. It is noticeable that this adherence influences decisions/attitudes on radiation risks.

In 1982, a vivid description of the strength of this attachment to nuclear power was presented by a former Commissioner of the US Nuclear Regulatory Commission, Peter Bradford. He noted that attachments to nuclear power can often amount to a near-religious obsession. He stated: https://www.nytimes.com/1982/03/09/us/a-nuclear-overseer-and-his-fears.html

> *"If a Secretary of Agriculture endorsed better meat inspection, you wouldn't have a debate of near religious fervor about whether that person was pro- or anti-meat, or whether he had sold out to the vegetarians. You'd debate whether the stricter regulations made sense. It's somehow unique to nuclear power that, when one refuses to have nuclear power on the industry's terms, one gets chucked into a bin labelled 'antinuclear'".*

Of course, the question exists as to whether the opposite may be the case: that is, whether those who oppose nuclear power unduly emphasise radiation risks. As authors, we are alert to this bias and guard against it.

In this connection, we are sometimes asked what our own attitudes are on nuclear power as an energy resource. We recognise that the subject is often debated, and that nuclear power is currently a source of US/European electricity and part of several Governments' current plans to reach net-zero emissions. However, nuclear power is not without risks, and it produces radioactive wastes that last for millennia. In addition, its connections with nuclear weapons raise ethical questions about proliferation. As such, nuclear power remains a contentious matter with complex trade-offs.

While we declare our attitude on nuclear power, many scientists on public-funded bodies and official bodies dealing with radiation risks usually refrain from doing so, and may often be unaware of their unconscious bias toward nuclear technology. We think they should recognise and declare their biases.

Writing Style

Radiation risk is not an easy matter for most people to grasp: we cannot see, hear, feel or smell radiation. Therefore to facilitate comprehension this book is written in a journalistic style, rather than in formal academic prose. However this does not indicate an absence of academic rigour, for example all scientific statements are referenced, and we pitch this book to the level of college students.

On the other hand, it does mean that jargon words are avoided or at least explained. We also try to define all technical terms. The Technical Annexes at the end explain the forest of abbreviations and the dozens of acronyms which regrettably infest the topic of radiation risks, and the Glossary explains many technical terms. It also means that complicated topics are often moved into the 14 Appendices in order to free up the flow of the biographies in the book.

Literary Conventions

UK English spelling and grammar rules are used throughout. “Chornobyl” is the Ukrainian spelling and is preferable to the Russian spelling “Chernobyl” as the nuclear power plant is located in Ukraine. The word “government” is not capitalised, except at the start of a sentence.

The phrase “nuclear establishment” is defined as including government energy departments (eg the US DOE, the UK DESNZ), government defence departments, nuclear weapons facilities (of which about dozen exist in the US alone), nuclear research laboratories, nuclear power research bodies, nuclear regulatory bodies, nuclear industry associations, and various radiation protection bodies including the US NCRP, IAEA, UNSCEAR, UKONR, WHO, ICRP, and the OECD-NEA. See Annex A for acronyms.

This book will be using the word “risk” exclusively to mean probability, i.e. the chance that radiogenic effects such as cancer will occur after an exposure. This is explained further in Appendix K.

The scientists listed in Part C are listed in date of birth order: in some cases where this information is not available, we have placed the scientists in approximately the correct date order. In some cases, photographs of scientists have not been shown due to copyright restrictions.

References are placed at the end of each Chapter, Appendix and Annex.

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Chapter 2
Official Monopoly on Radiation Studies

Professor Robert Proctor has stated (Proctor, 1995)

> *"Health physicists have tended to monopolise the field of radiation studies making it difficult for dissenting views to gain a hearing."*

The point is that, in the past, if one's views were considered dissenting or oppositional by mainstream reviewers from bodies such as the ICRP, US EPA, UNSCEAR, IAEA etc., then they often were simply not published. (These official bodies are described in Appendix B.)

A major problem was (and still is to some extent) that relatively few people outside the nuclear or medical establishments have the qualifications, training and/or expertise in radiation or radioactivity to comment upon or to write informed articles on these matters. Unfortunately these subjects are taught in relatively few schools, colleges and universities on either side of the Atlantic.

In fact, the problem goes even deeper. To fully understand radiation risks and to discuss them authoritatively, requires expertise in radiation biology, radiation physics, radiation chemistry, quantum mechanics, epidemiology, statistics, and probability theory. And to understand internal radiation risks, add expertise in human anatomy, human metabolism, human biochemistry and cellular biology. In other words, much experience, knowledge and education are required.

The result is that, when it comes to discussing radiation and its risks, environmentalists and lay persons are often hesitant about getting involved or putting their heads above the parapet. People are concerned not to make mistakes or to appear unversed on radiation risks, and justifiably so.

There is another fear operating here. Many scientists concerned about radiation risks have seen what happened to dissenting scientists in the past and are rightly apprehensive that the same official disapprobation (including loss of their contracts) might be meted out to themselves should they stray from the officially-accepted line.

For all these reasons the subject of radiation risks has unfortunately become a virtual "no go" area for lay persons and independent-minded scientists. The corollary is that official organisations have a *de facto* monopoly on the subject of radiation risks.

One of the aims of this book is to attempt to remedy this problem by presenting information on radiation and its risks in easily understood terms. See Part B and the Scientific Appendices, Technical Annexes, Bibliography and Useful References.

Official Secrecy

Another deeply disquieting problem exists here - official secrecy. Historian Professor Kate Brown has revealed (Brown, 2020) that, at least as regards the radiation risks arising from the 1986 Chornobyl disaster, both the US government and the USSR government kept a great deal of information secret. She stated

> *"….thirty-four years after the Chernobyl accident, we are still short on answers and long on uncertainties. Ignorance about low-dose exposures is tragic and far from accidental, an ignorance that exposes the breach between open and classified research. We stand with a leg on each side of a crevasse between those two bodies of scholarship."*

She added that this deep ravine between open and classified knowledge was essentially due to the Cold War.

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Chapter 3
Discreditation, Disapprobation and Opprobrium

The scientists discussed in Part C below have suffered in various ways from official discreditation and disapprobation which often led to their public opprobrium. We need to define these terms.

Few academic studies have examined official disapprobation and public opprobrium, at least in scientific contexts. However, in 2021, Vandenberg and Goldberg at the School of Public Health at the University of Massachusetts published an instructive list of strategies used by large corporations in the tobacco, pharmaceutical and other industries to discredit opponents and to promote their science agendas on cigarettes, drugs, chemicals etc. Six of their cited tactics involve discrediting opponents, as follows:

- attack (dissenters') studies
- misrepresent (dissenters') data
- abuse peer-review
- employ hyperbolic or absolutist language
- attack opponents (ie personally)
- abuse dissenters' credentials

These tactics have all been found in the case histories of the dissenting scientists in Part C.

Just as bad as damage to people is damage to, or distortion of, the scientific information base. For example, Goldberg and Vandenburg cited the following tactics damaging to science which are disquieting

- suppress incriminating information
- contribute misleading literature

- blame other causes for adverse effects
- inappropriately question causality
- make straw man arguments

We have seen many official articles which denigrated scientists also employed the above science-damaging tactics.

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Part B:
Radiation Risks

Chapter 4
Recent Evidence of Increased Risks of Cancer

Definition of "Risk"

Before we discuss the scientific evidence on radiation risks, we need to untangle what we mean by the word "risk".

High levels of exposures to radiation can have many harmful effects as discussed in Appendix K, including skin reddening, hair loss, and loss of immune responses etc. These are radiation's <u>hazards</u>. In addition, low levels of exposures increase the <u>probabilities</u> of cancers, cardio-vascular diseases, strokes and other effects.

In everyday conversation the word "risk" is often used to mean either or both of these things, i.e. a hazard and/or a high probability. But this can lead to mix-ups when the word is used to mean one thing when the other is meant.

This book will be using the word "risk" exclusively to mean probability. This is explained in Appendix K.

For example, the current ICRP (see acronyms in Technical Annex A) radiation risk for adults, i.e. the probability of contracting a fatal cancer in future after receiving a given dose of radiation, is 5% per sievert of radiation. (A sievert is a unit of radiation dose - usually abbreviated as Sv. See Technical Annex C).

A practical illustration of this risk can be shown via collective doses, as follows. If 1,000 adults each received 1/1000th of a Sv of additional radiation (ie one mSv each) then 5% of them (ie 50) would die from cancer in the future. (As explained in Appendices A and E, many problems exist with the value of 5% per Sv. In particular, it was established in the 1960s and has not been increased since then, despite much evidence that it should be.)

Some Background

Ever since the discoveries of radiation by Roentgen and of radioactivity by Becquerel at the end of the 19th century, the history of radiation and radioactivity and their health effects is long and dispiriting. For example, several of the pioneer researchers of radiation and radioactivity suffered illnesses or were killed by the subject of their research.

In fact, the history of mankind's experiences with radiation and/or radioactivity is littered with episodes of near-manic enthusiasms followed a few months or years later by rueful realisations of unexpected ill-health, gruesome injuries, deaths and frequent lawsuits. This happened for example with early X-ray machines, radium dial painting (as discussed in Appendix J), a multitude of so-called radioactive "health" curatives, quack radiation practices, radioactive panaceas, visits to radon mines, and so on (Caufield, 1995). These episodes invariably ended in tears.

We should not think this process has stopped. The warnings about the profligate use of CT scans by Professor Hall (2009, 2008, 2002) and Professor Brenner (2020, 2014, 2012, 2012a, 2001) and more recently by Professor Hauptmann et al (2022) illustrate the need to keep vigilant. (References are located at the end of each chapter).

These academics have raised concerns about the widespread and increasing use of computerised tomography (CT) scans and from medical diagnostic and intervention techniques, as these result in high collective radiation exposures to the public.

Finally here, we need to accept the consistent finding that the more we learn about radiation, the more dangerous it has been perceived, certainly by independent observers. For example, recent studies provide strong evidence that radiation exposures to nuclear workers increase the incidences of not just certain cancers, but also cardiovascular disease (CVD), dementia/Alzheimer's disease and now brain cancer - hitherto unsuspected as being caused by radiation.

These new radiogenic risks are discussed in chapter 5 below.

The INWORKS Studies

Current risks from radiation (expressed solely in terms of cancer deaths per Sv of exposure) are broadly set out in the 2006 report of the US National Academy of Sciences' BEIR VII report (US National Research Council, 2006). These are based on the Life Span Study (LSS) of approximately 85,000 Japanese survivors of the atomic bombs dropped on Hiroshima and Nagasaki in 1945.

However, more recent epidemiological evidence has been published indicating that the LSS-based risks are too low and need to be increased. This new evidence is from the International Nuclear Workers' Study (INWORKS) (Hamra et al, 2016) a metastudy of about 310,000 nuclear power workers in the US, UK and France. Nuclear workers in these studies were exposed to radiation which was measured in their film badges and TLD dosimeters, of which records had been kept for many years.

In epidemiology, size is all-important as the larger the study the more confidence we have that its findings are real and not chance occurrences. The INWORKS studies cover four times as many exposed people than the LSS study, which lends considerable authority and statistical weight to their findings. Indeed, these new risks should now be used for setting radiation safety limits etc. rather than the LSS study.

The INWORKS studies have examined three radiogenic effects to date: leukaemia/ lymphoma (Leuraud et al, 2015, 2021); solid cancers (Richardson et al, 2018, 2023); and circulatory diseases and non-cancer diseases (Gillies et al, 2017).

These INWORKS studies have found evidence that current perceptions of radiation risks are too low and need to be increased. Given their importance, the findings from INWORKS are discussed further in Appendix A.

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