Radiation Safety Institute of Canada
Institut de radioprotection du Canada

Radiation Protection Past, Present, & Future A Conversation with the Former Scientific Secretary of the ICRP

Guest: Jack Valentin, Consultant, Radiological Protection at Karolinska Institutet

March 21, 2025

Good Science in Plain Language®

Radiation Safety Institute of Canada
Institut de radioprotection du Canada

Land Acknowledgement

Webinar Functionality

Audio and video

- During the presentation, from the presenters only
- Captions: More>Language and speech>Turn on live captions

Use the Chat feature to talk to discuss with everyone

Use Q&A feature to ask questions for Q&A portion

Posted on webinar page

- Video, answers to questions, copy of the slides

Follow up email will be sent

- Topics covered, time of attendance

In This Session

Presentation by Jack Valentin

- Former Scientific Secretary of ICRP
- Past, present, and future of radiological protection

Questions from host

Questions from participants

Movement break

- Charlmane Wong
- Ji Hong Tai Chi & Qi Jong Richmond Hill

A Path Map

- When we began to understand radiation
- The history of ICRP
- Current understanding and state of radiological protection
- Thoughts about the future

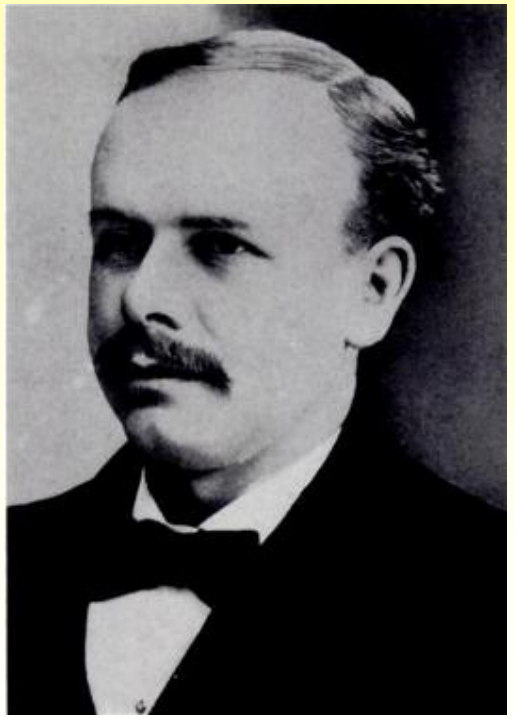
Radiation: Useful But Dangerous

- **1895 – Röntgen discovers x rays**

- **1896 – E Grubbé contracts x-ray dermatitis**
- **W Fuchs publishes advice for hands**

'Keep exposure as short as possible
Keep at least 12 inches (30 cm) from the tube
Coat exposed skin with vaseline'

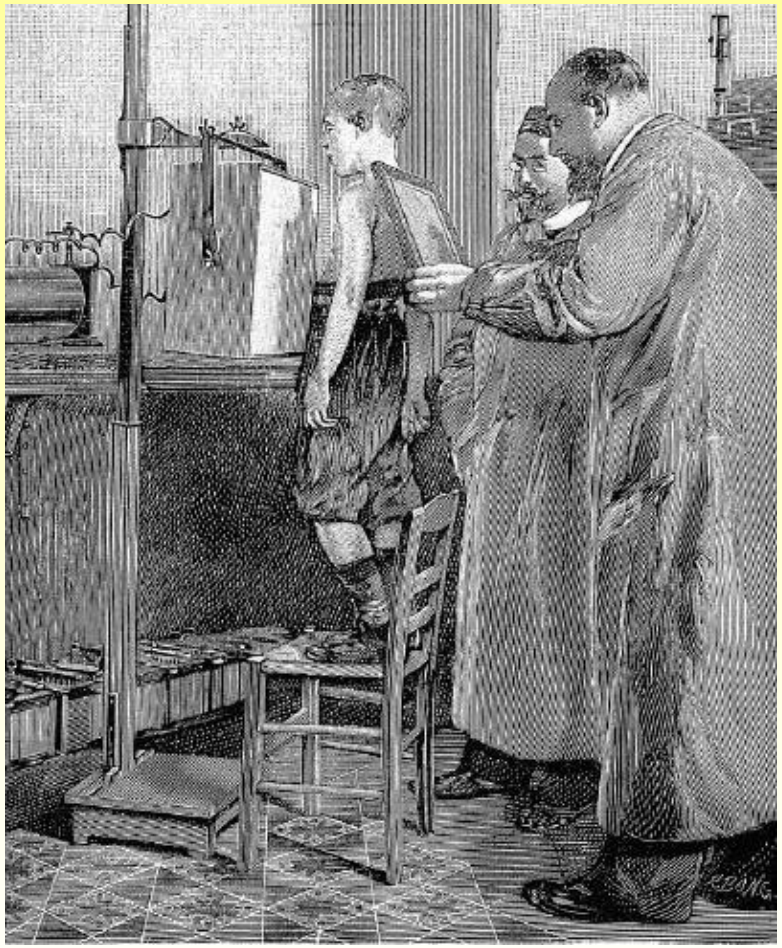
= after 1 year, the 'GOLDEN RULES':
TIME
DISTANCE
SHIELDING



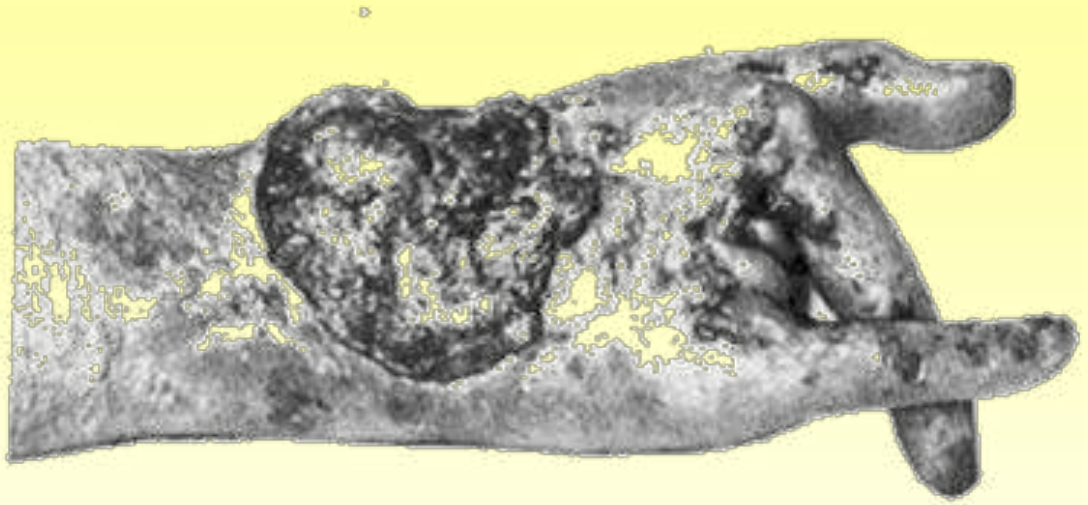
The State Of Knowledge Around 1902

- **1896: X-ray dermatitis (Drury 1896)**
- **1897: Mobile x-ray units at the battlefield (Churchill 1898)**
- **1899: Radiotherapy (Mould 1993)**
- **1902: Radiation induced skin cancer (Frieben 1902)**

~1920: Escalating Radiation Safety Concerns



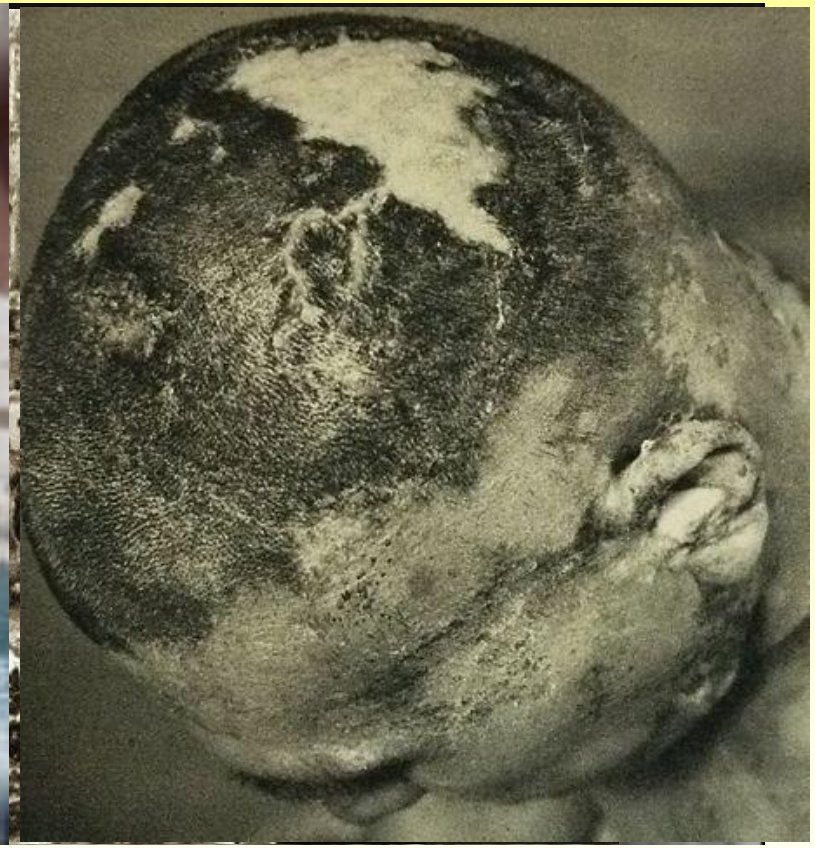
Frequent use…



…and many injuries
(amputated hand of Paul Krause,
Röntgen-Museum Remscheid)

But The Spirit Of The Times Was Reckless

After 1950: Public Radiation Perceptions Changed



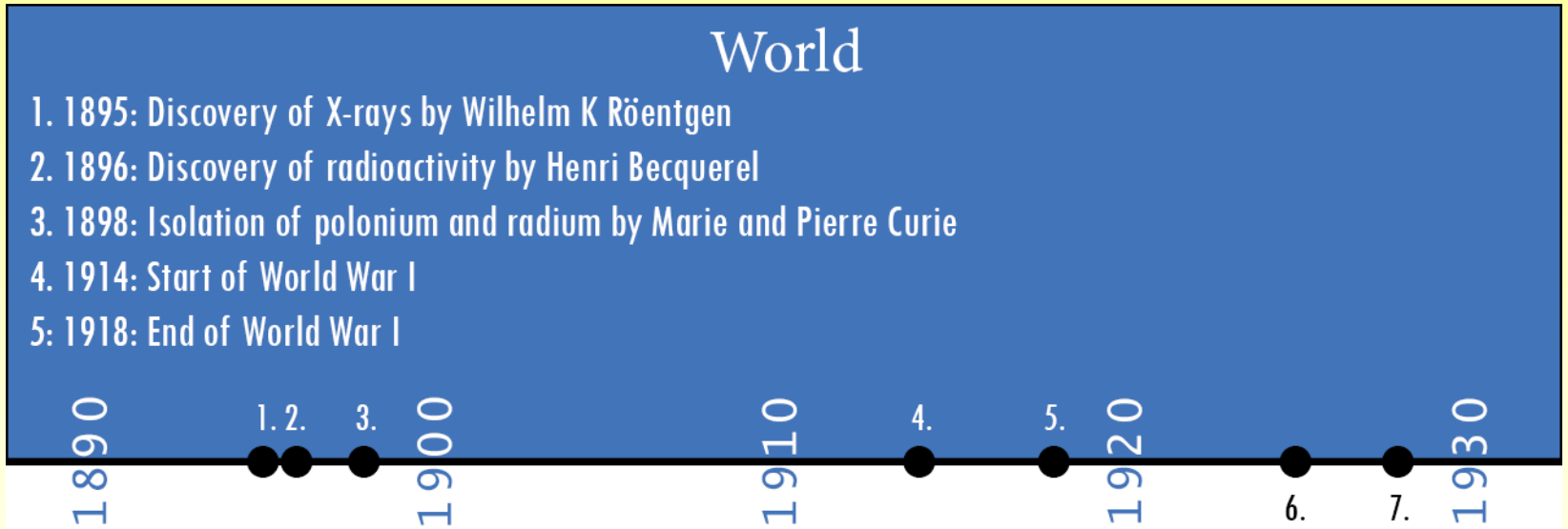
Many nuclear weapons tests

1954: ‘Bravo’ (Bikini), ‘第五福龍丸 (Lucky Dragon 5)’

1955: Excess leukaemia in Hiroshima, Nagasaki

The History of ICRP

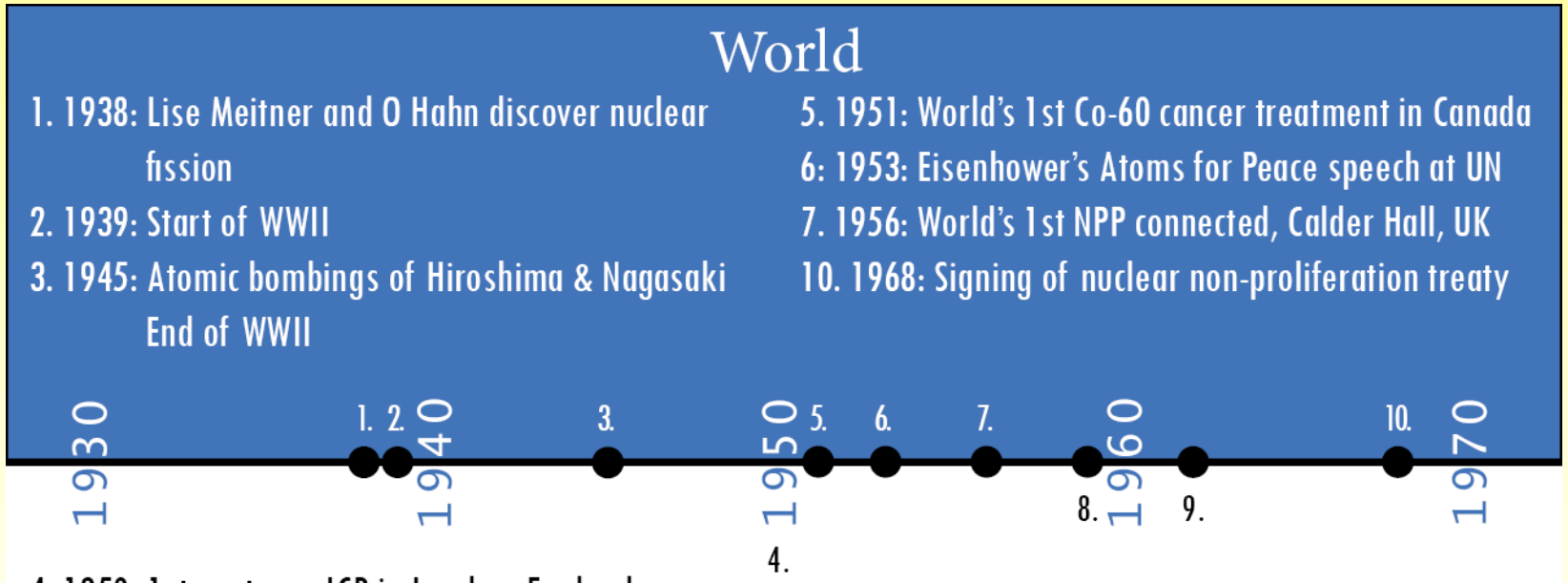
1890 - 1930



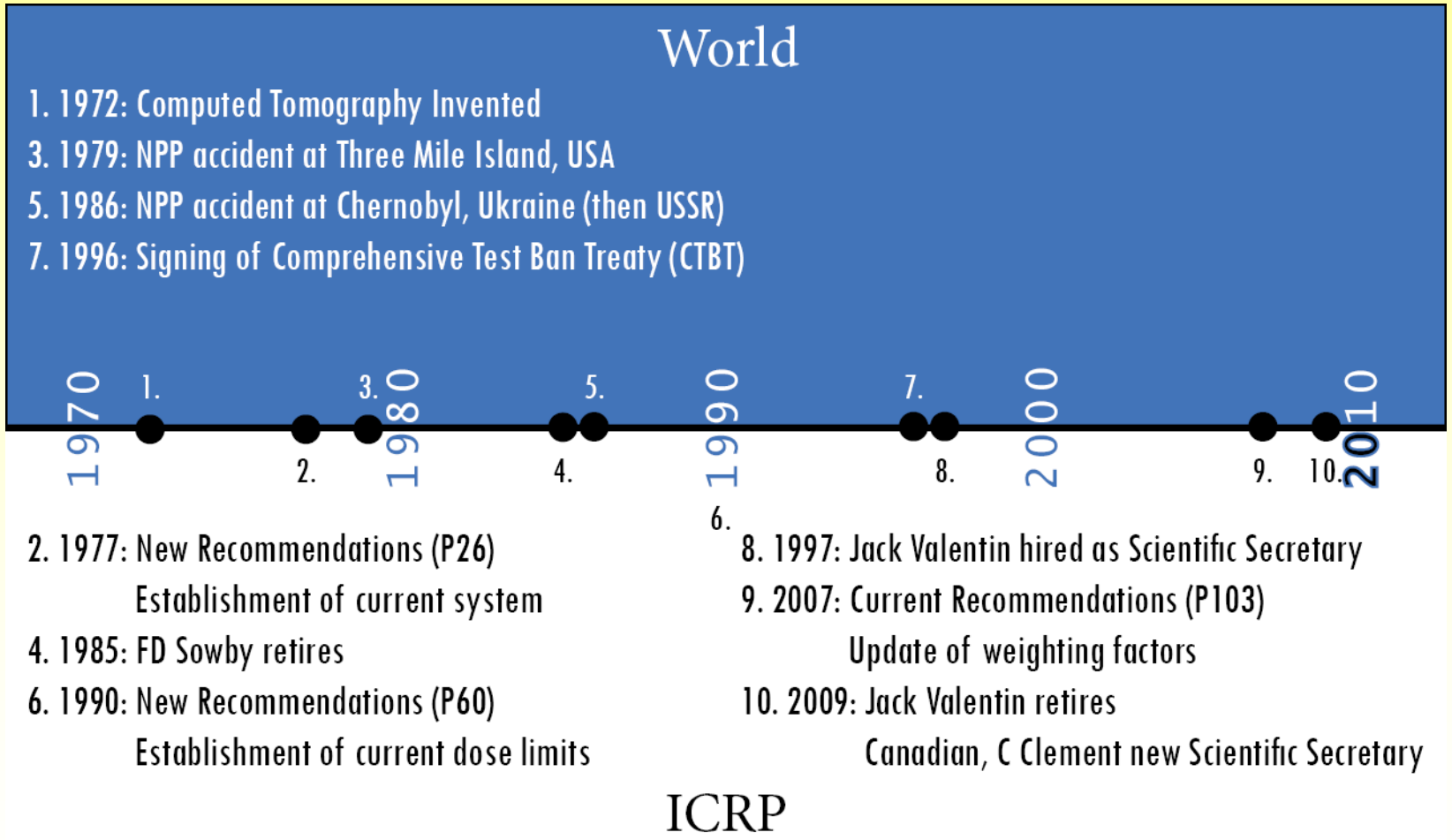
6. 1925: 1st International Congress of Radiology (ICR) in London
International X-ray Unit Committee formed
7. 1928: At ICR in Stockholm the International X-ray and Radium Protection Committee (IXRPC) formed
First Recommendations issued

ICRP

1930 - 1970


World
1. 1938: Lise Meitner and O Hahn discover nuclear fission
2. 1939: Start of WWII
3. 1945: Atomic bombings of Hiroshima & Nagasaki
End of WWII
5. 1951: World's 1st Co-60 cancer treatment in Canada
6: 1953: Eisenhower's Atoms for Peace speech at UN
7. 1956: World's 1st NPP connected, Calder Hall, UK
10. 1968: Signing of nuclear non-proliferation treaty
1930
1940
1950
1960
1970
1. 2. 3. 5. 6. 7. 8. 9. 10.
4.
4. 1950: 1st post-war ICR in London, England
IXRPC renamed ICRP
8. 1959: 1st post-war Recommendations published in ICRP's own series
9. 1962: 1st full-time, paid Scientific Secretary: UK-Irish-Canadian, FD Sowby
ICRP

1970 - 2010


World
1. 1972: Computed Tomography Invented
3. 1979: NPP accident at Three Mile Island, USA
5. 1986: NPP accident at Chernobyl, Ukraine (then USSR)
7. 1996: Signing of Comprehensive Test Ban Treaty (CTBT)
1970
1980
1990
2000
2010
1.
2.
3.
4.
5.
6.
7.
8.
9.
10.
2. 1977: New Recommendations (P26)
Establishment of current system
4. 1985: FD Sowby retires
6. 1990: New Recommendations (P60)
Establishment of current dose limits
8. 1997: Jack Valentin hired as Scientific Secretary
9. 2007: Current Recommendations (P103)
Update of weighting factors
10. 2009: Jack Valentin retires
Canadian, C Clement new Scientific Secretary
ICRP

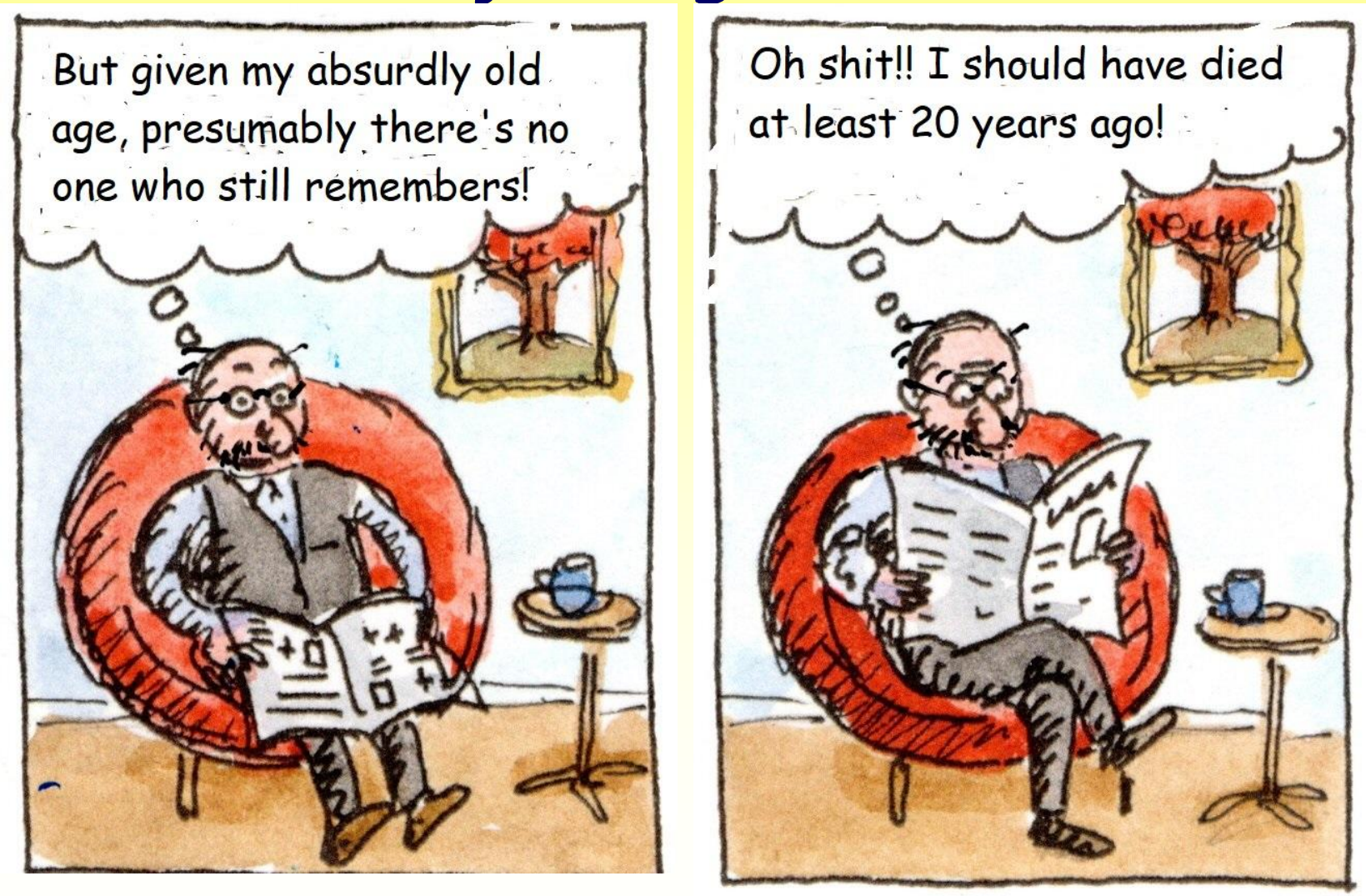
2010 -

2. 2012: ICRP Statement on Tissue Reactions (P118)
   Establishment of new dose limit for the lens of the eye
   Cautionary statement on cardiovascular disease

ICRP

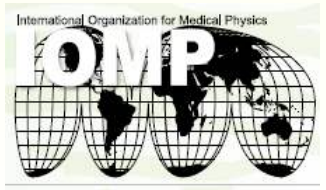
Perils of Being A Has-Been

Perils of Being A Has-Been



Current State of Things

Selected International Organisations



Some Canadian ICRP Members

DV Bates

J Bouchard

GC Butler

AJ Cipriani

G Cowper

RM Duncan

C Garrett

HE Johns

Chris Clement

CA Mawson

M Measures

HB Newcombe

RV Osborne

SD Simpson

FD Sowby

CG Stewart

EW Vogt

EA Watkinson

Average Individual Radiation Doses

Source	Global Average Dose (mSv per year)
Radon	**1.3**
Natural sources	**1.1**
Occupational	**0.005**
Civil Nuclear Power	**0.0002 mSv** (max 0.02)
Atmospheric Nuclear Testing	**0.005**
Chernobyl Accident	**0.005**
Medical Diagnosis	**0.6**

From UNSCEAR

- **Medical = the major source of *artificial exposure*, by far**

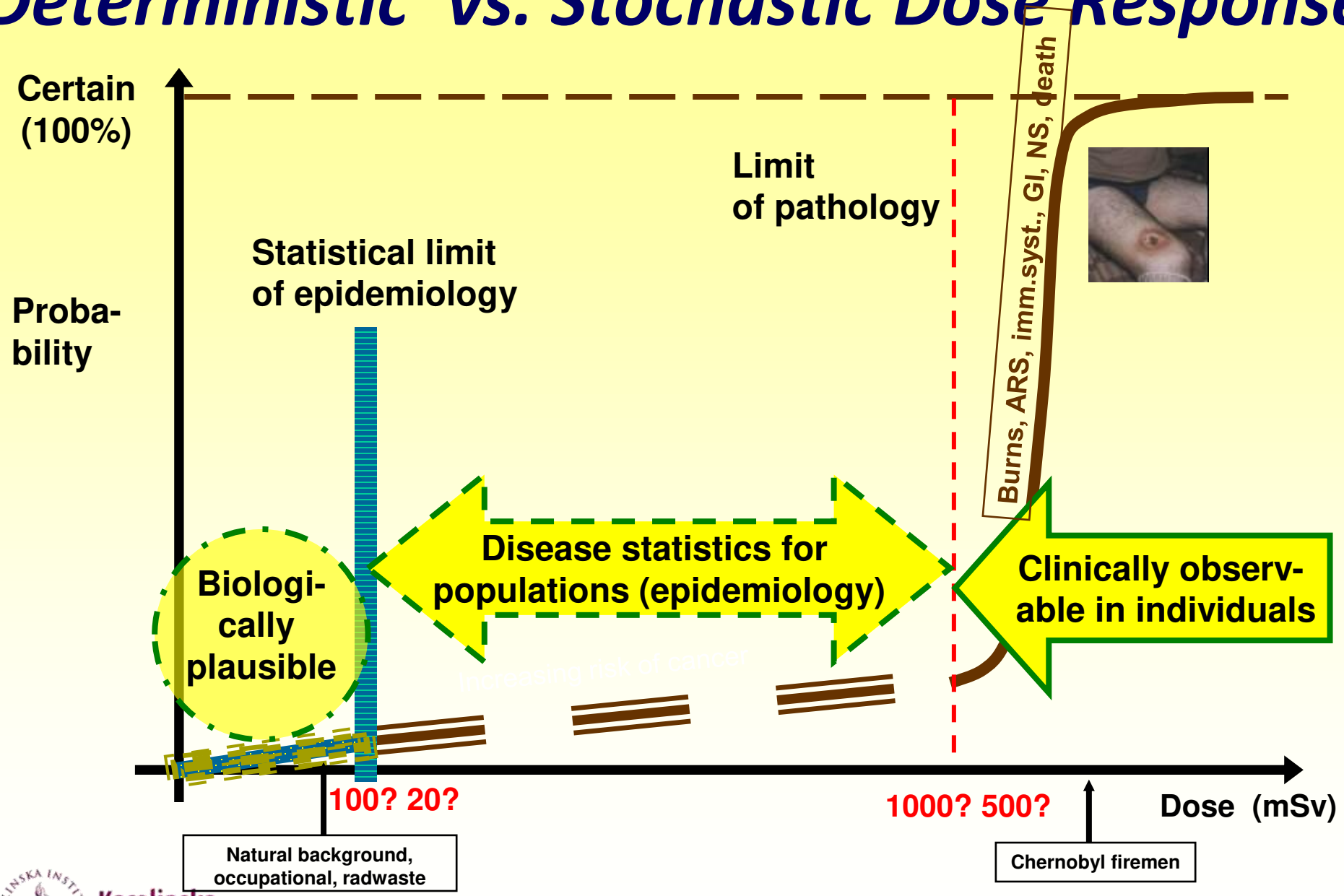
ICRP On Dose Calculation

- **Use Radiation Weighting Factors, w_R**
- **Use Tissue Weighting Factors, w_T**
- **Intakes require more complex assessments than external exposure, and…**
- **ICRP provides Coefficients for Dose [Sv] per unit Intake [Bq]**

Health Effects Of Radiation

- **'Deterministic' tissue/organ reactions (usually acute)**
  - *Skin damage: Erythema, epilation, wounds*
  - *Sterility (temporary/permanent)*
  - *Acute Radiation Syndrome*
    - *Bone marrow / Blood-forming organs*
    - *Gastro-Intestinal canal*
    - *CNS damage*
  - *Antenatal brain damage*
- **Stochastic effects (late)**
  - *Cancer*
  - *Genetic damage*
- **CHD, diabetes…**

'Deterministic' vs. Stochastic Dose Response



Nominal Probability Coefficients (% Sv $^{-1}$) For Stochastic Effects – What's The Risk?

Exposed population	Cancer	Heritable effects	Total detriment	1990:
Whole	5.5	0.2	5.7	7.3
Adult	4.1	0.1	4.2	5.6

A Reminder:

$$1 = 2$$

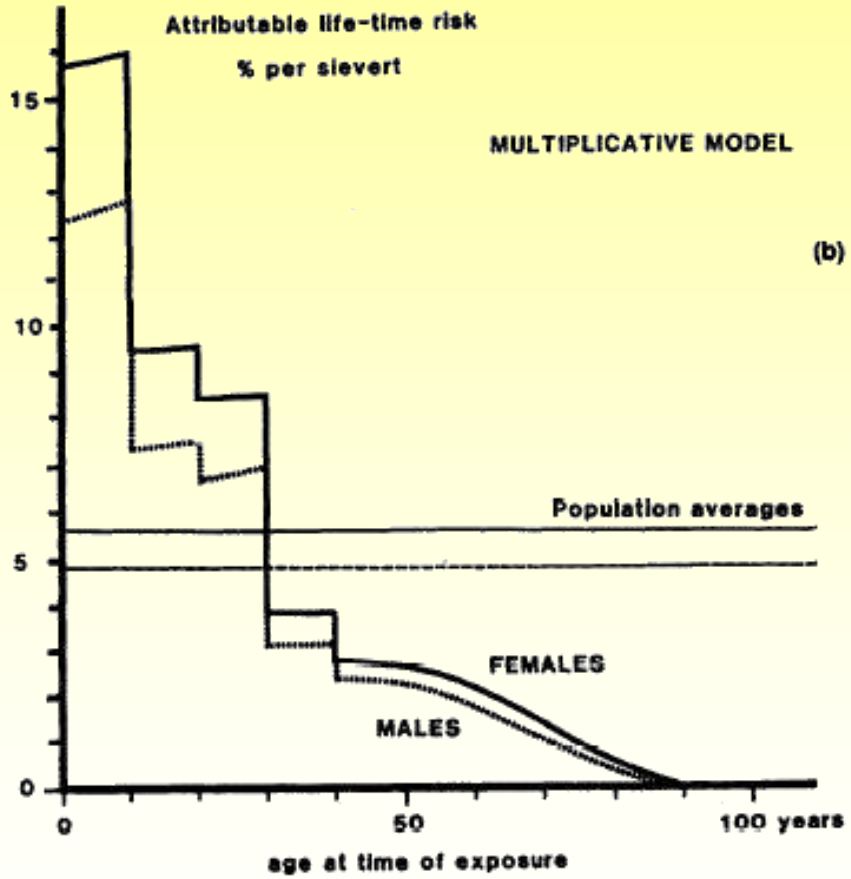
Females and Males

- **Nominal risk estimates for protection**
  Individual retrospective assessments require specific information

- **The average achieves adequate protection for both sexes**
  A value judgement, based on science

- **Thus, no need for sex-specific protection criteria**
  Precludes discrimination

ICRP Risk Estimates Are Age-Averaged…



- **BUT: for workers** (age 18-65) **or for the whole population**

- **AND: dose per unit intake coefficients (Sv/Bq) are age-specific**

  to take account of biokinetic differences

Future…

We Thought We Knew Everything…

- **LNT may not apply to non-targeted effects**
  - ***But does this affect the risks?***
  - ***Epidemiology assesses total risk***

- **Adaptive response to radiation**
  - ***A priming dose (~10 mSv) may confer some resistance against a 2nd dose***

- **Non-cancer disease: CHD etc, respiratory?, digestive?, cognitive?; lens**
  - ***Stochastic or 'deterministic'? Dose-response pattern?***

Countermeasures after Radiation Accidents

- **Agents decreasing uptake of selected nuclides**
  Most important: stable iodine - Prevents thyroid uptake of I

- **Agents increasing excretion of selected nuclides**
  Prussian blue; DTPA

- **Agents mitigating radiation effects**
  Antioxidants

And What Do I Expect?

- **2031-ish Next set of new Recommendations**
- **Some kind of attention to higher risk for females**
- **Possibly, also some age differentiation....**

BUT:

- **Some simplification of the system**
- **Fewer worries about very low doses**

  They cannot be completely disregarded

  But must not be reduced at the cost of other, bigger risks

Interview

- During the interview, feel free to post questions in the Q&A.

Questions?

- As time permits, we will address questions posted in the Q&A
- Questions we do not get to
  - Answers will be posted to our website and a link to resources emailed out

"Good science in plain language"®

Thank you for listening!

www.radiationsafety.ca

1-800-263-5803

info@radiationsafety.ca

Wellness Break

基宏太極拳學院

身輕體淨　心暢神舒

課程：理法精確，由淺入深，循序漸進

Our Curriculum is systematic, clear and accurate. It allows students to learn effectively and progress efficiently.

教練：經驗豐富，耐心細緻，親切友善

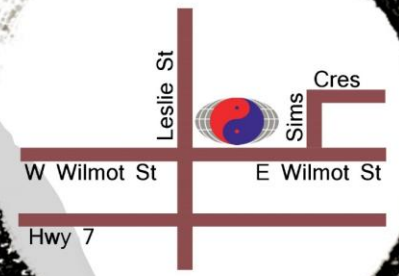
Our Instructors are experienced, patient and dedicated.
We pay close attention to individual progress.

Phone 647-921-1368
中文電話 647-388-0083
www.TaiChiOntario.com

總教練 – 梁寶森師傅
Chief Instructor - Bao Sen Liang

Ji Hong Tai Chi

Tai Chi keeps you Healthy in Mind, Body and Soul



10 East Wilmot St. Unit 21
Richmond Hill, Ontario

Ji Hong Tai Chi & Qi Gong, Richmond Hill, ON