Uranium Medical Research Centre
UMRC

Washington • New York • Toronto • London

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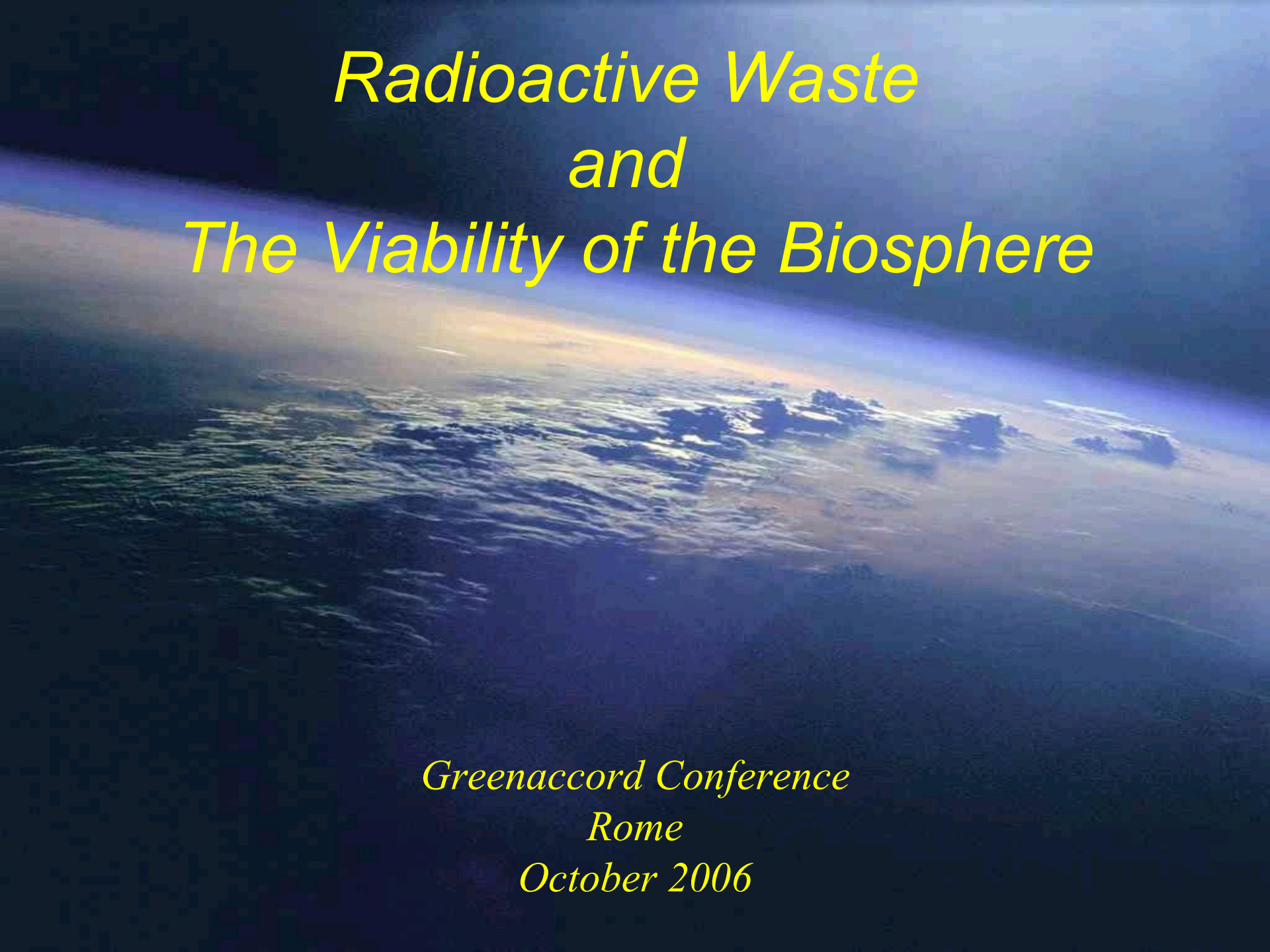
Toronto • New York • Washington • London



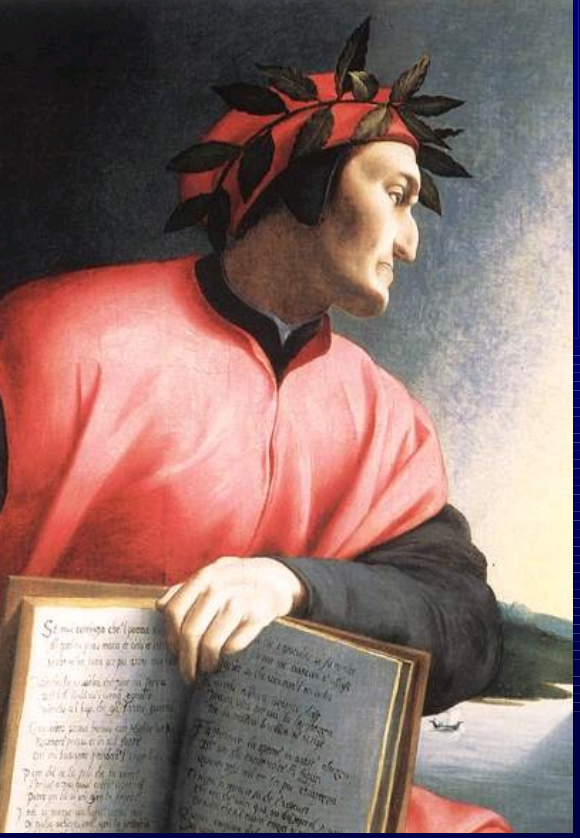
Radioactive Waste and The Viability of the Biosphere

Greenaccord Conference
Rome
October 2006

Contents

- History of radioactive contamination of the biosphere
- Testing of the Nuclear Weapons
- Effects on Humans
- Radioactive Waste
- Industrial and Military radioactive waste
- Not so depleted Uranium
- Our current research
- Survival of the Planet Earth
- The Future


The End ?



“Per me si va nella città dolente
per me si va nell'etterno dolore
per me si va tra la perduta gente.

Giustizia mosse il mio Alto Fattore
Fecemi la Divina Potestate.
La somma sapienza, e il primo amore

Dinnanzi a me non fuor cose create
Se non etterne. E io etterna duro.
Lasciate ogni speranza, voi ch‘entrate.”

History of radioactive contamination of the biosphere

Erz Mountains

Central Europe

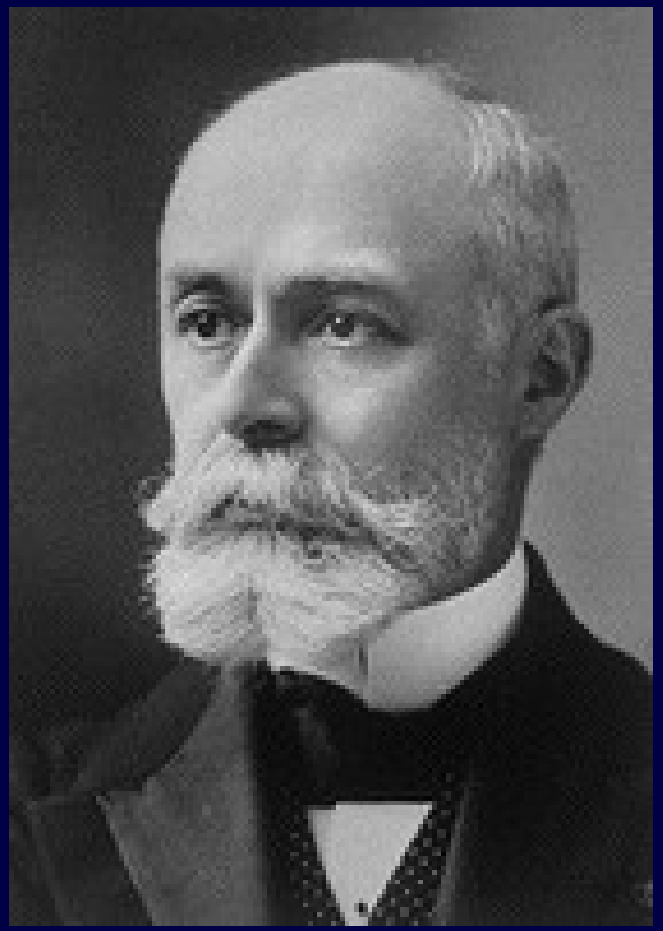
16th Century

Pitchblende – Mountain Sickness

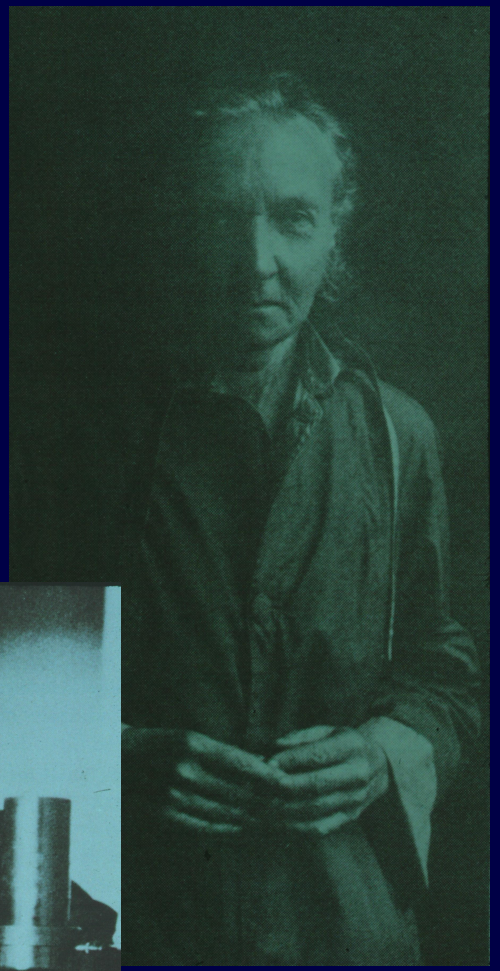
Antoine-Henri Becquerel

discovers radioactivity

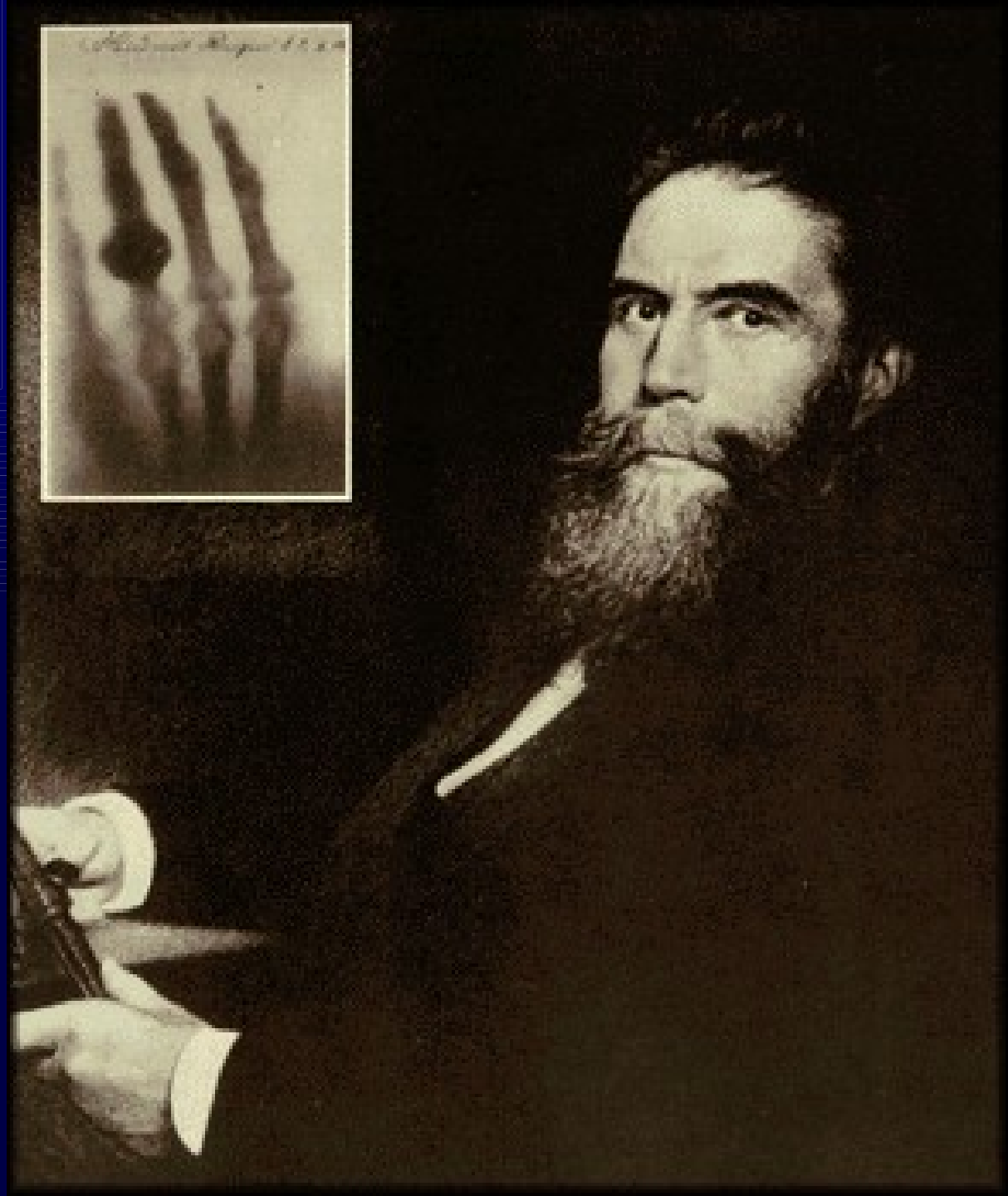
- 1896 -



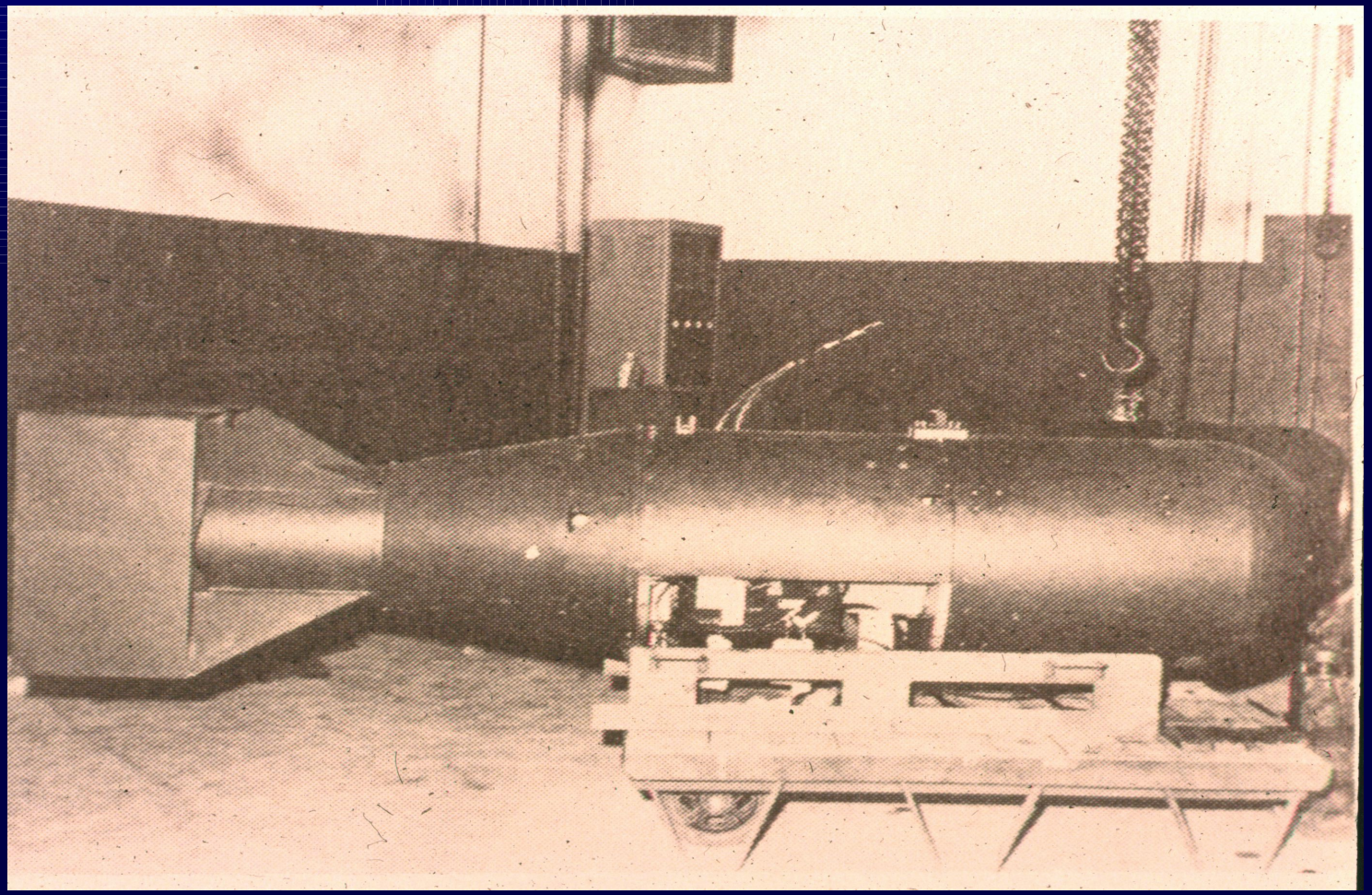
The Curies



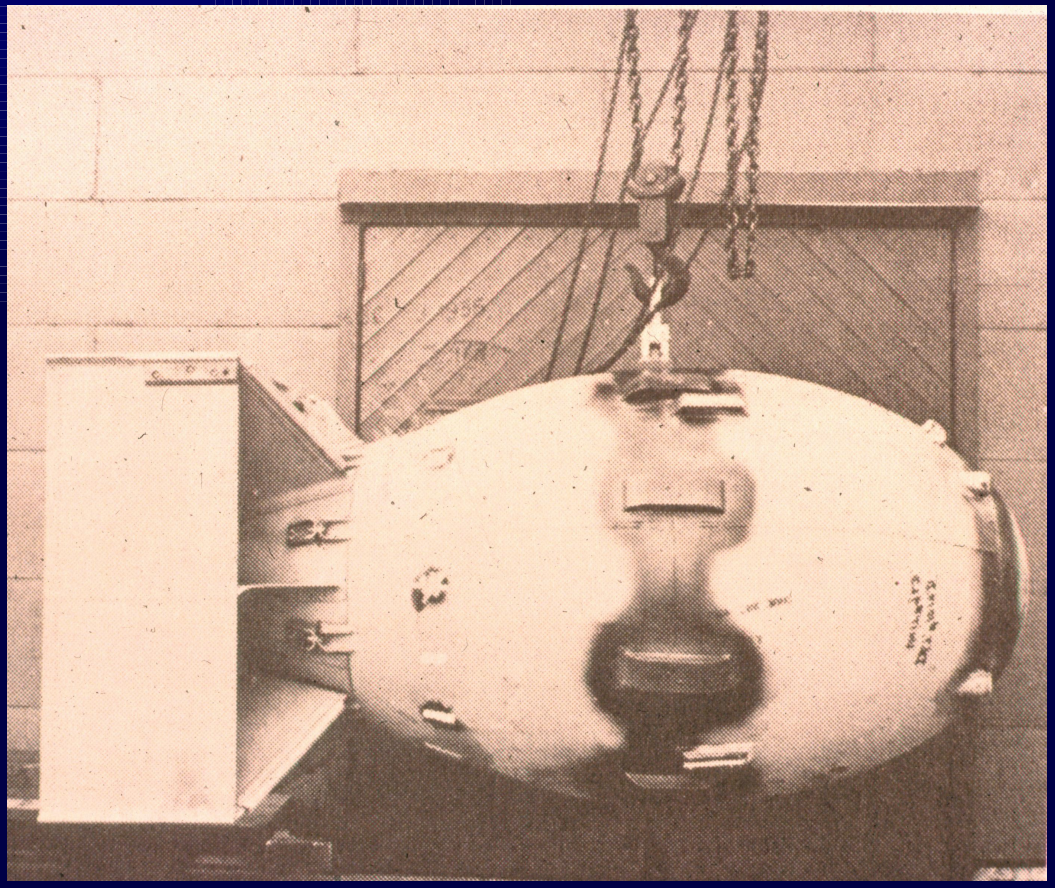
Wilhelm Conrad Roentgen



First Atom Bombs



First Atom Bombs

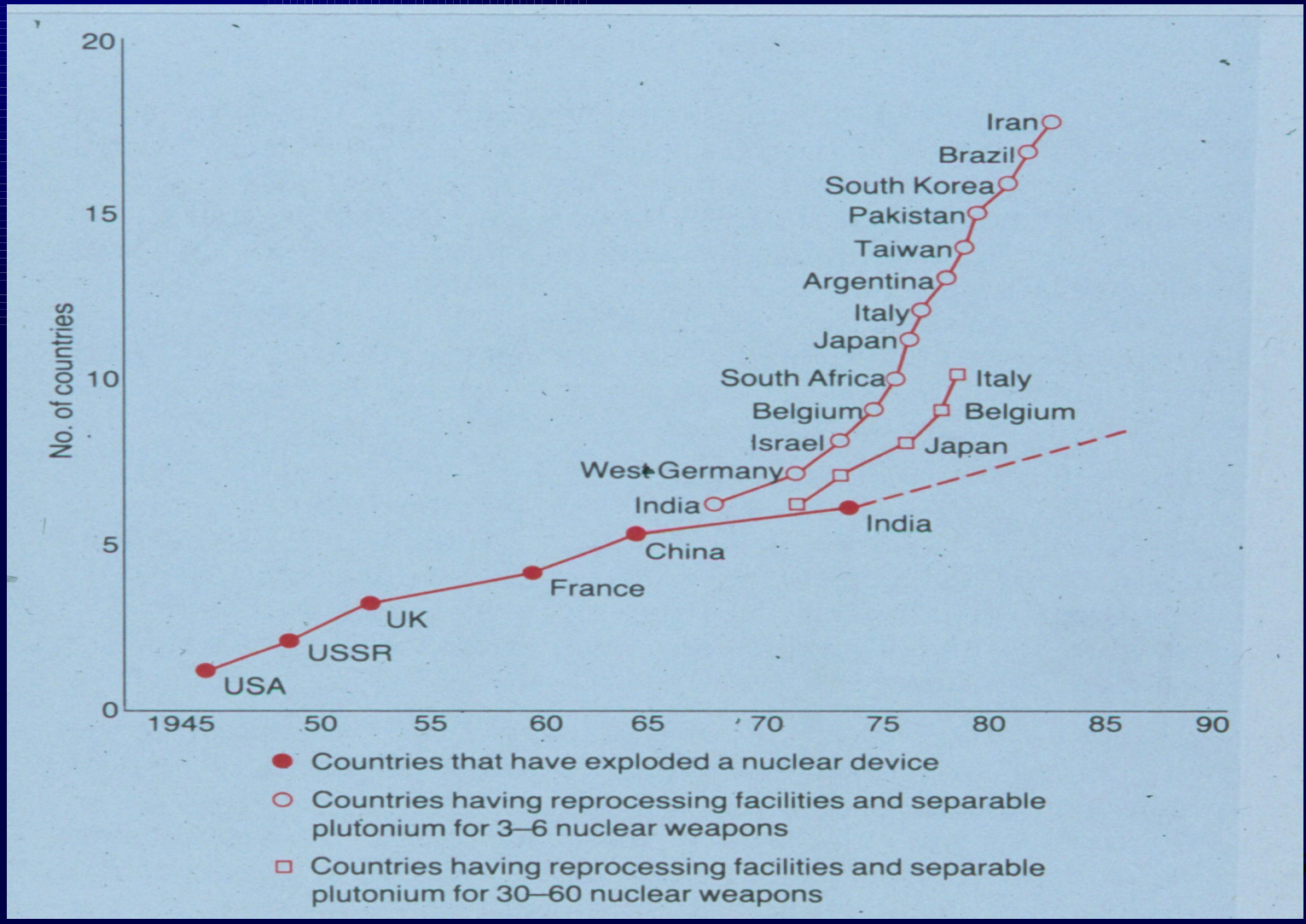


Chernobyl

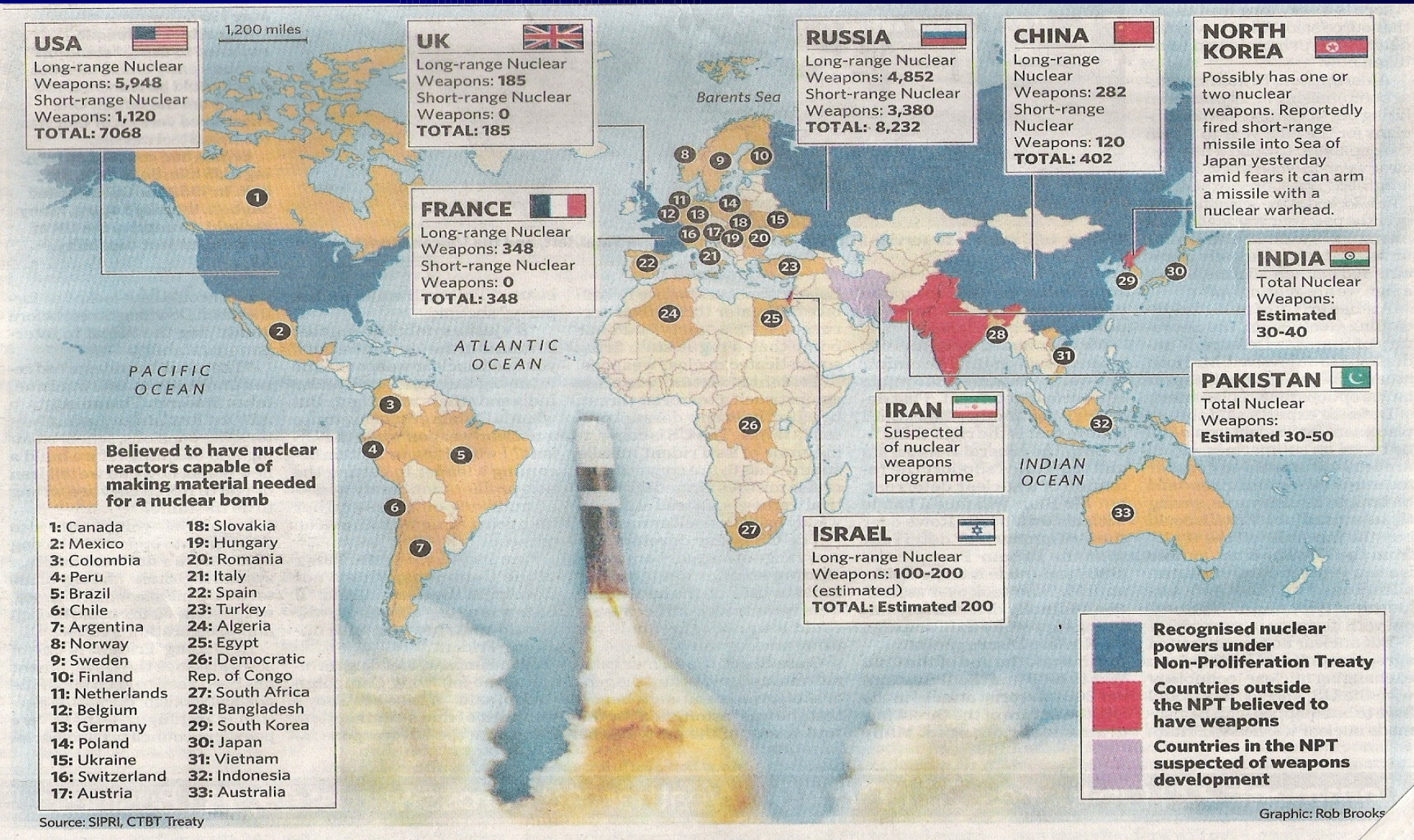
April 26, 1986

Black Rain

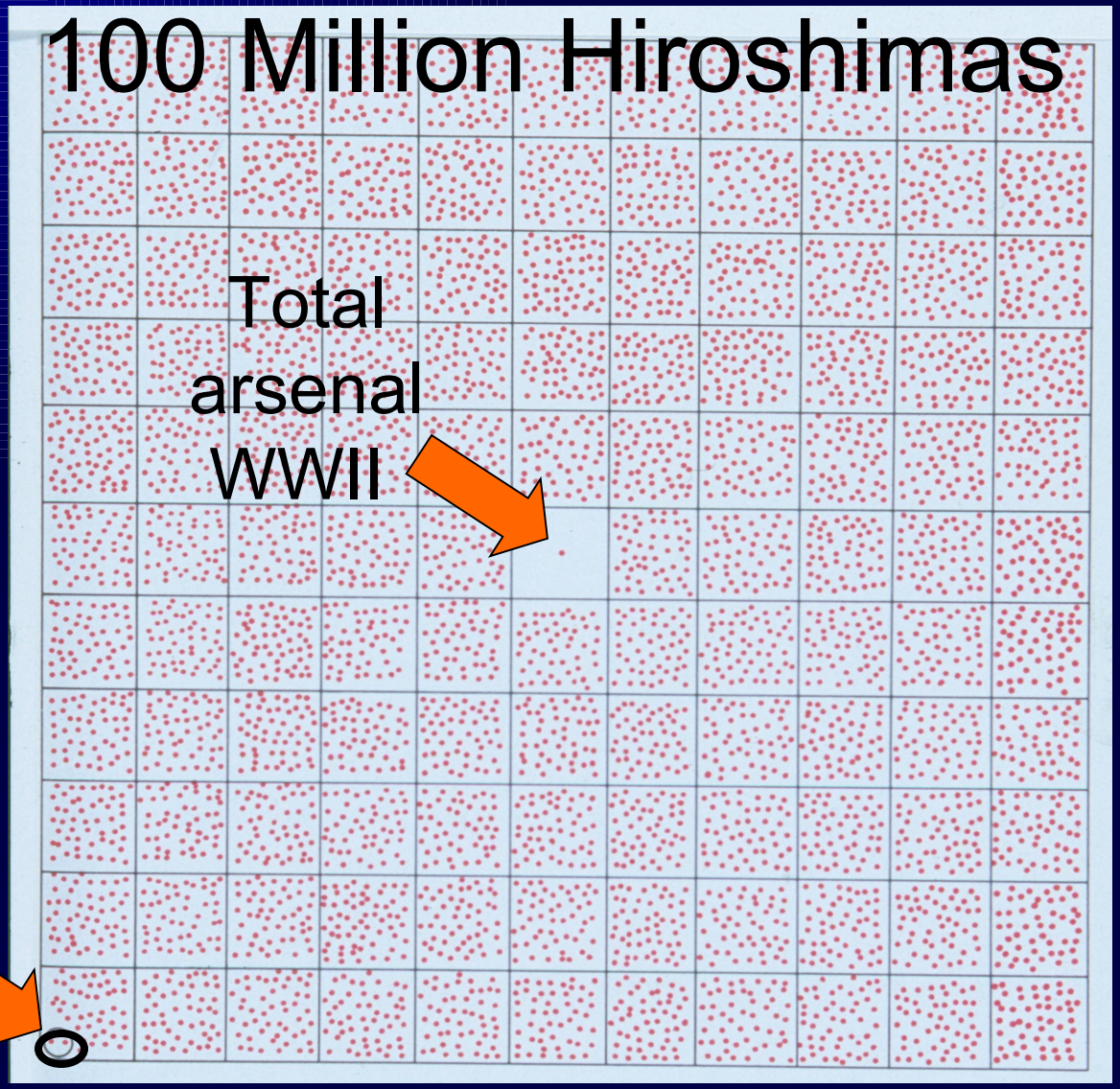
Nuclear Proliferation
The Nuclear Club



The Global Nuclear Arsenal today



The Nuclear Arsenal Today



Testing of the Nuclear Weapons

Atmosphere

Oceans

Subterranean

Effects on Humans

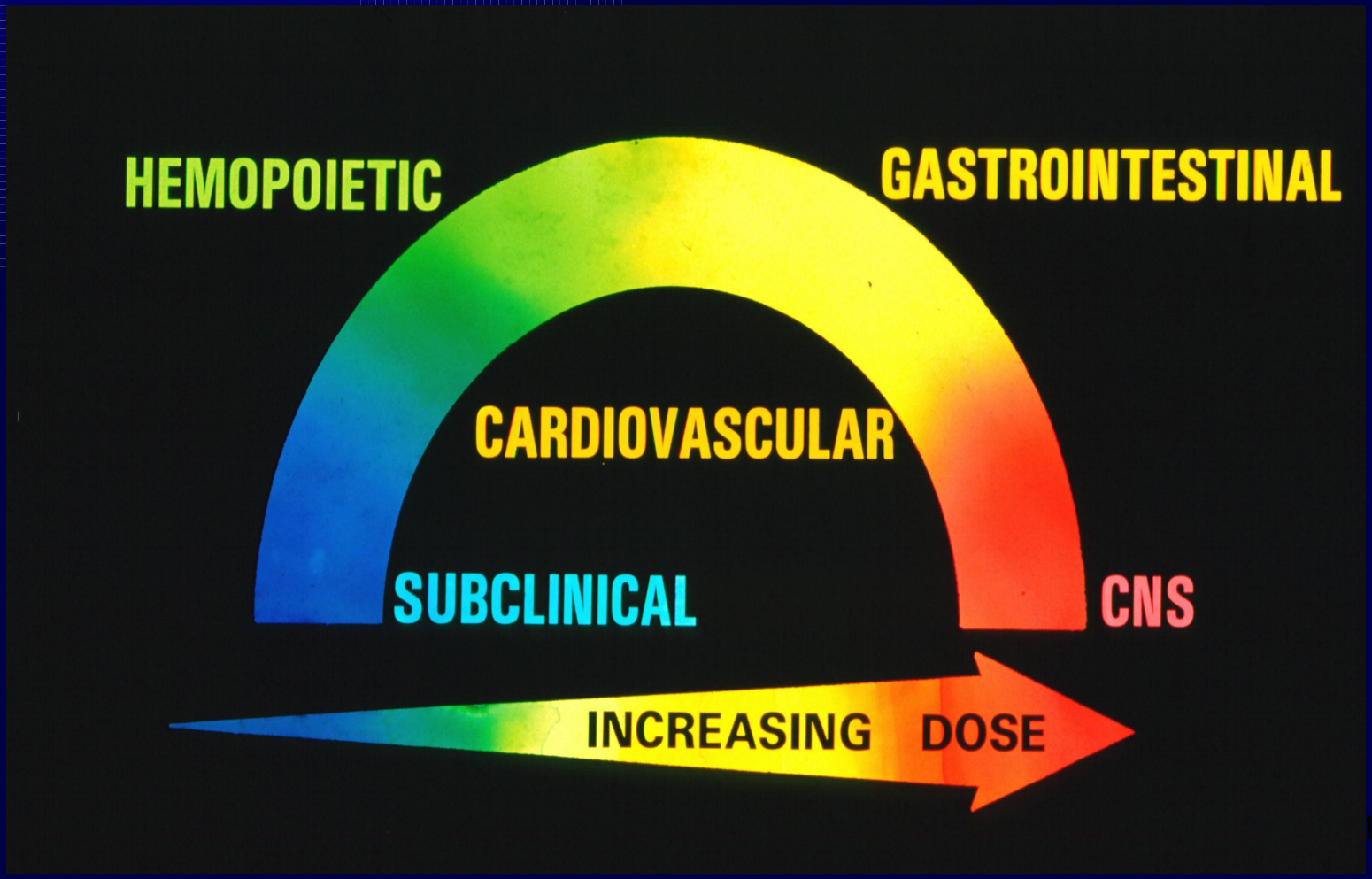
Local Radiation Injury


R

Examples for Acute Radiation Syndromes

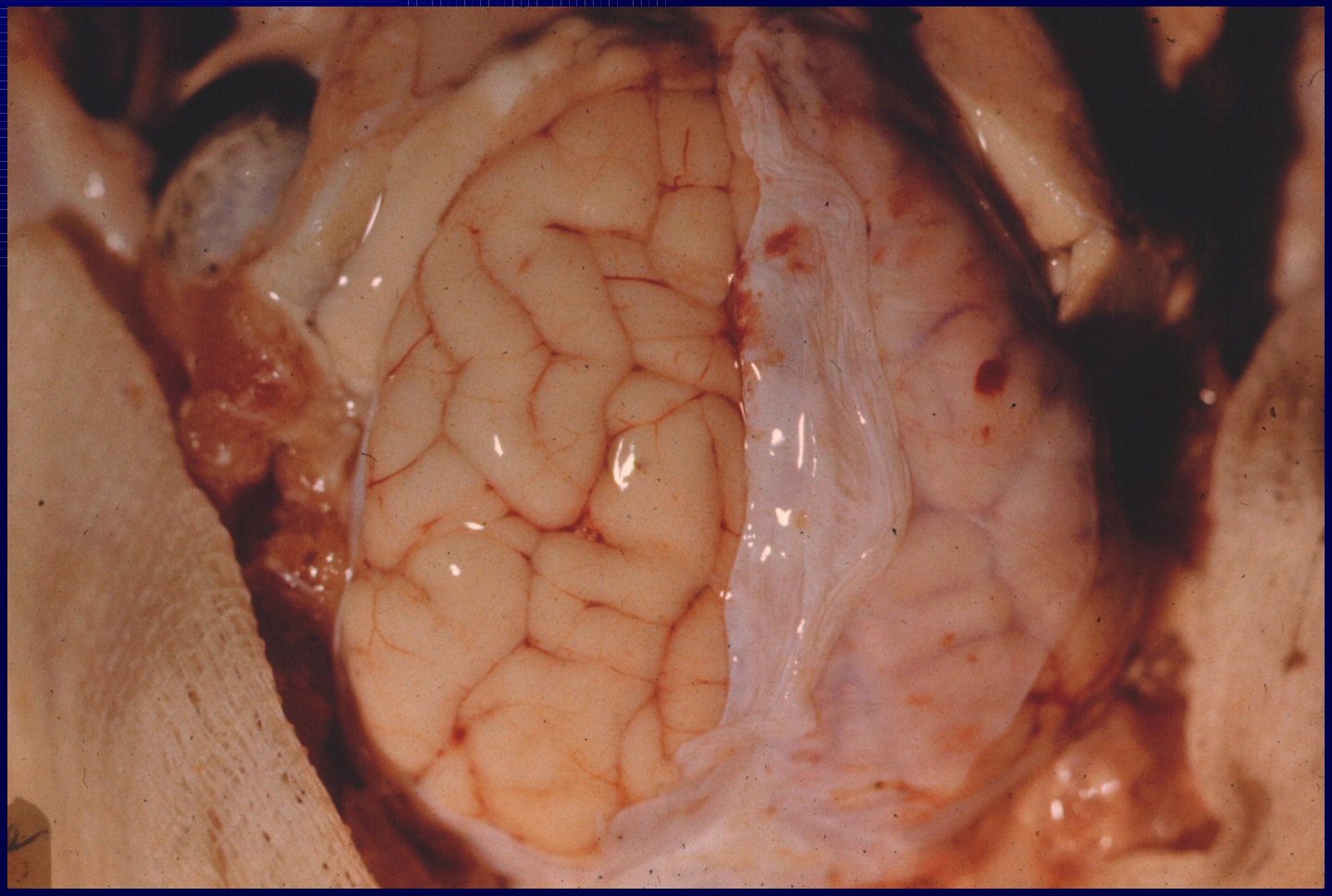
Acute Radiation Syndrome (ARS)

ARS
Dose Rate & Spectrum of Disease



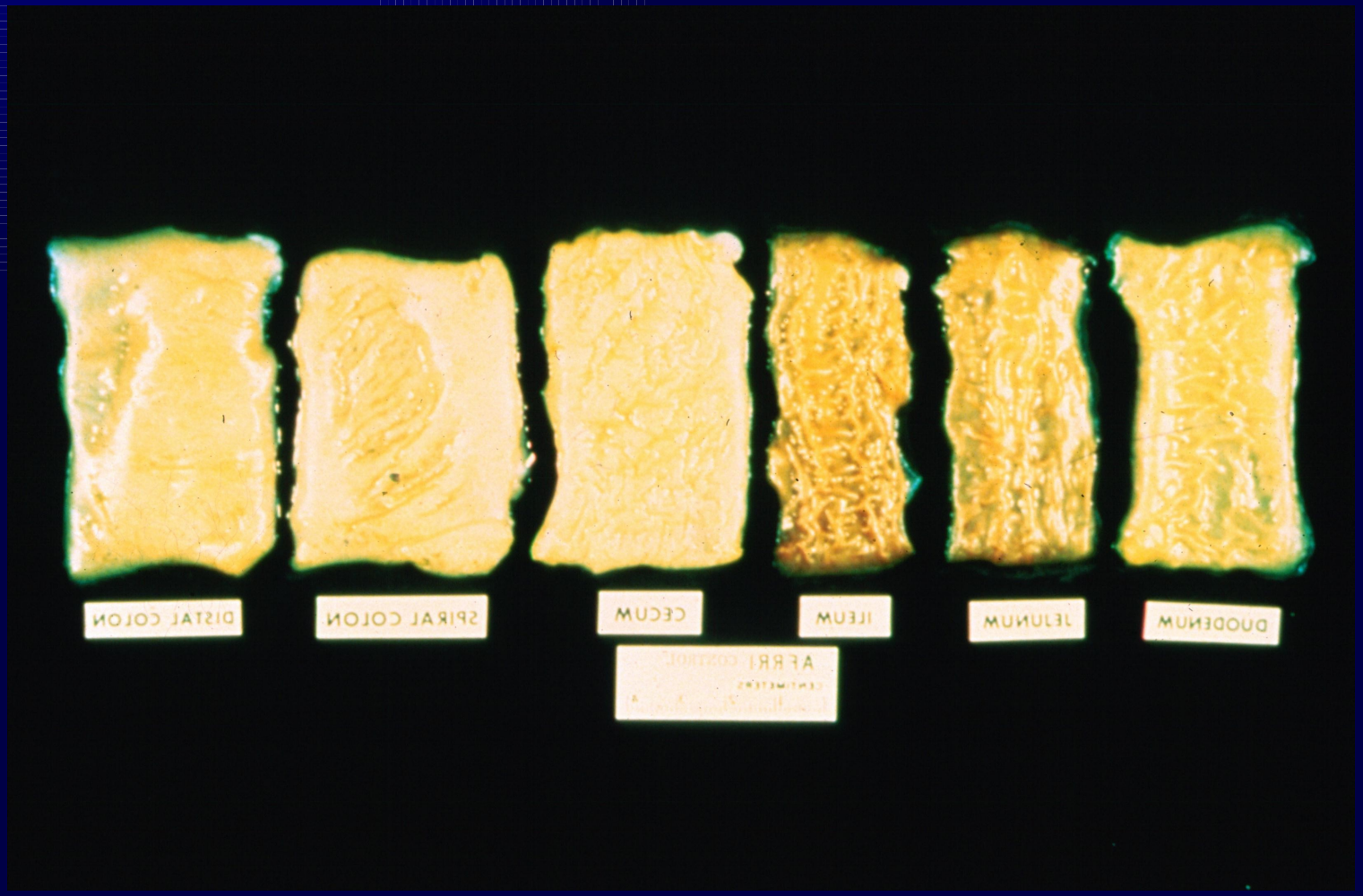
Radiated Heart

Brain Edema

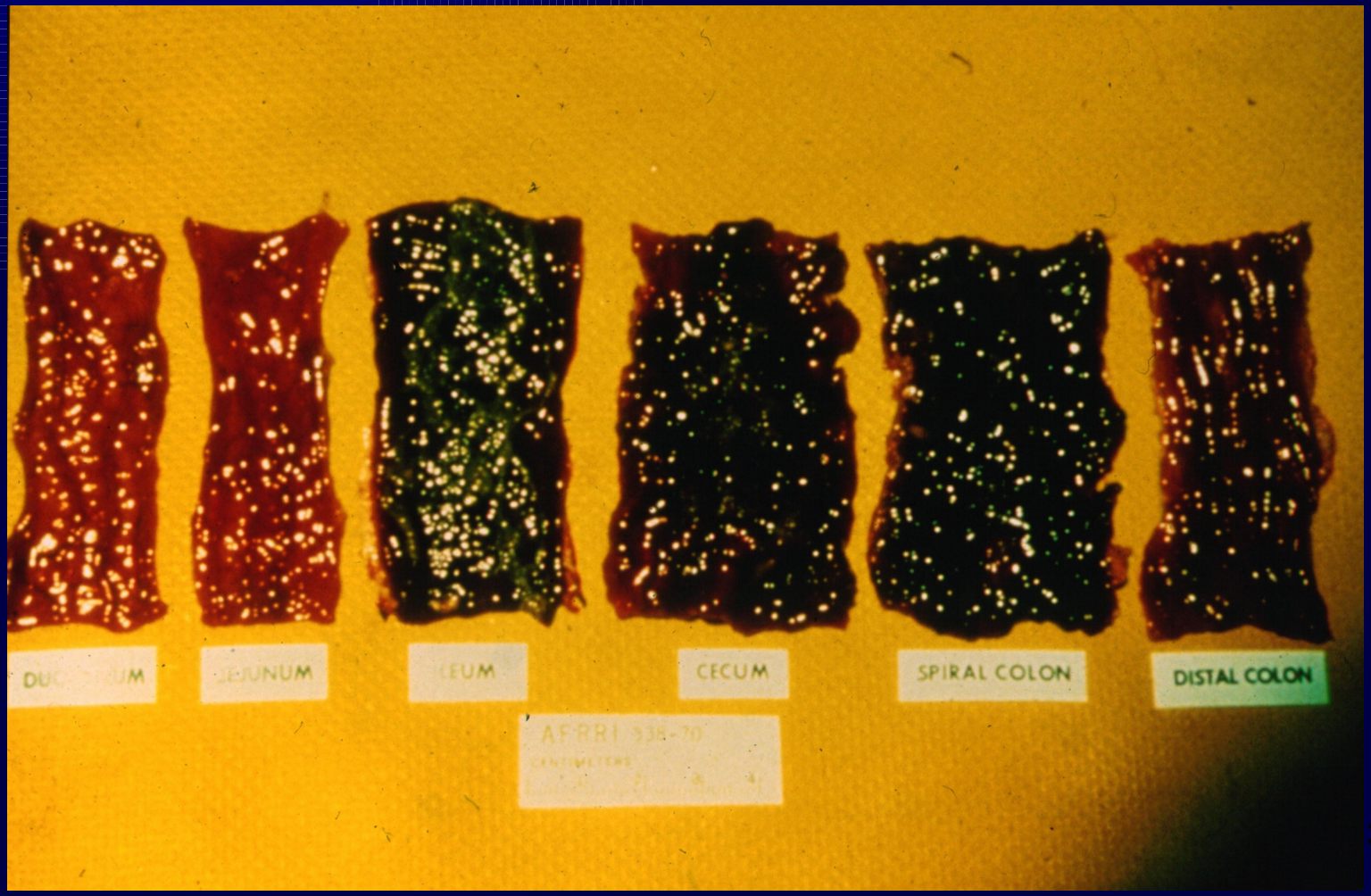


Gastrointestinal Effects

Intestinal samples : normal



Intestinal samples : irradiated



Acute Radiation Syndrome

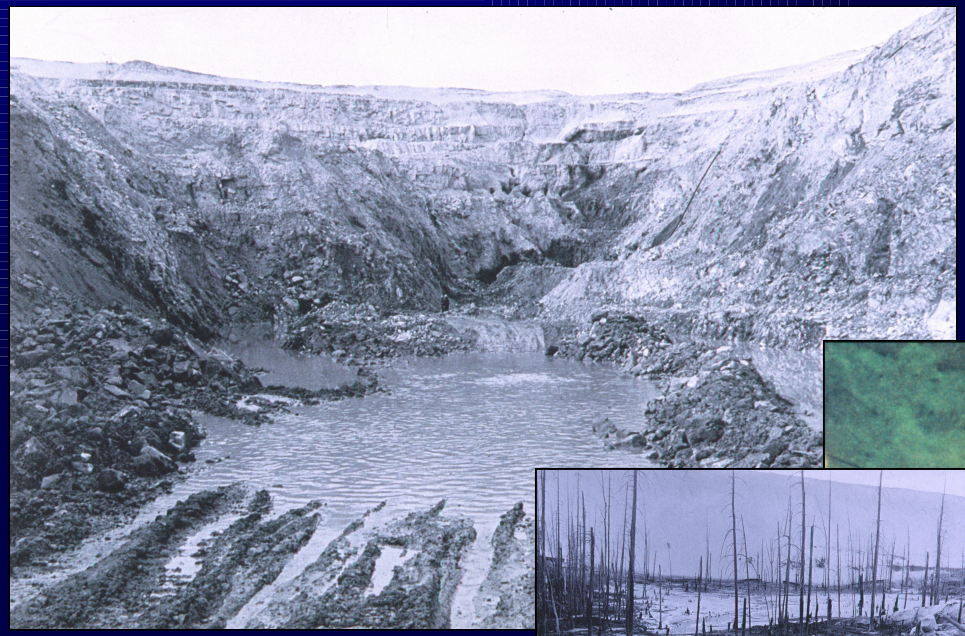
Medical Conclusions

- The role of medicine in nuclear and radiological warfare is limited due to the universal lack of preparedness in the management of consequences of acute radiation syndrome, combined injuries, or the contamination of the biosphere and human population.
- Radiation casualty preparedness lessons from Gulf War I, the Balkan Conflict, Afghanistan and more recently Gulf War II have not yet been adequately addressed.

Radioactive Waste

- Industrial
- Medical
- Military

Uranium Mining & Radioactive Waste



Uranium Mining

Radioactive Waste

Industrial Radioactive Waste

Nuclear Fuel Cycle

- The beginning of the cycle
- The enrichment
- The end of the cycle

Radioactive Waste Proliferation

- Active Nuclear Reactors
- High level waste
- Reactor grade Plutonium
- Nuclear Fuel Reprocessing

Nuclear Weapons Reprocessing

- Processing of the Reactor Fuel
- Plutonium and other Transuranic Elements

Physical and Biochemical Properties of Radioactive Waste

- Spent fuel
- Long physical half-life
- Particle emission
- Decay products
- Organ-specificity
- Long biological half-lifes

The Levels of Radioactive Waste

- Low level (LLRW):
- Intermediate level (ILRW)
- High level (HLRW)
- Transuranic waste (TRUW)
- Remote Handling

Management of Radioactive Waste

- Medium level waste
- High level waste

Storage of Radioactive Waste

- Long term storage
- Vitrification
- Stainless steel containers
- Welding seals
- Hot cell systems
- Borosilicate glass
- Phosphate glass
- Mandatory HAW vitrification (Europe)
- Synthetic rock (Australia)

Disposal of Radioactive Waste Underground

- Deep ground repositories :
  Switzerland & Sweden
- Endlager:
  Gorleben village in Wendland, Germany
- Final repository:
  Yucca Mountains, Nevada, USA
- Possible global repository:
  Australia & Russia
- Earth's mantle:
- Abyssal Plane (below the earth's crust)

Seas and Ocean Repositories

- Not approved by North America & Europe

Remix and Return

- Blending high level waste and mill tailings to the original radioactivity of uranium ore
- Deposition in empty uranium mines

Transmutation

- Integral fast reactor
  - Does not produce radioactive waste
  - Consumes transuranic waste:
  - Not approved by U.S. Government
- Sub critical reactors:
  Transmutation of transuranic elements
- Theoretical Fusion Reactors:
- International Thermonuclear Experimental Reactor
- Possible future: Transmutation of actinides with simultaneous generation of 1GigaWatt of electricity per reactor
- Russian and Ukrainian studies of biological transmutation

Disposal into space

- Jettisoning into the outer space
- Rockets carrying 100 tonnes of radioactive waste
- Crash on the surface of the moon
- Deorbiting waste into the sun
- Unreliable concept (Challenger Shuttle)
- Gas core nuclear rocket

Radioactive Waste Accidents

Kishtym Explosion
1957

Military Radioactive Waste

GW I & II Ammunition:

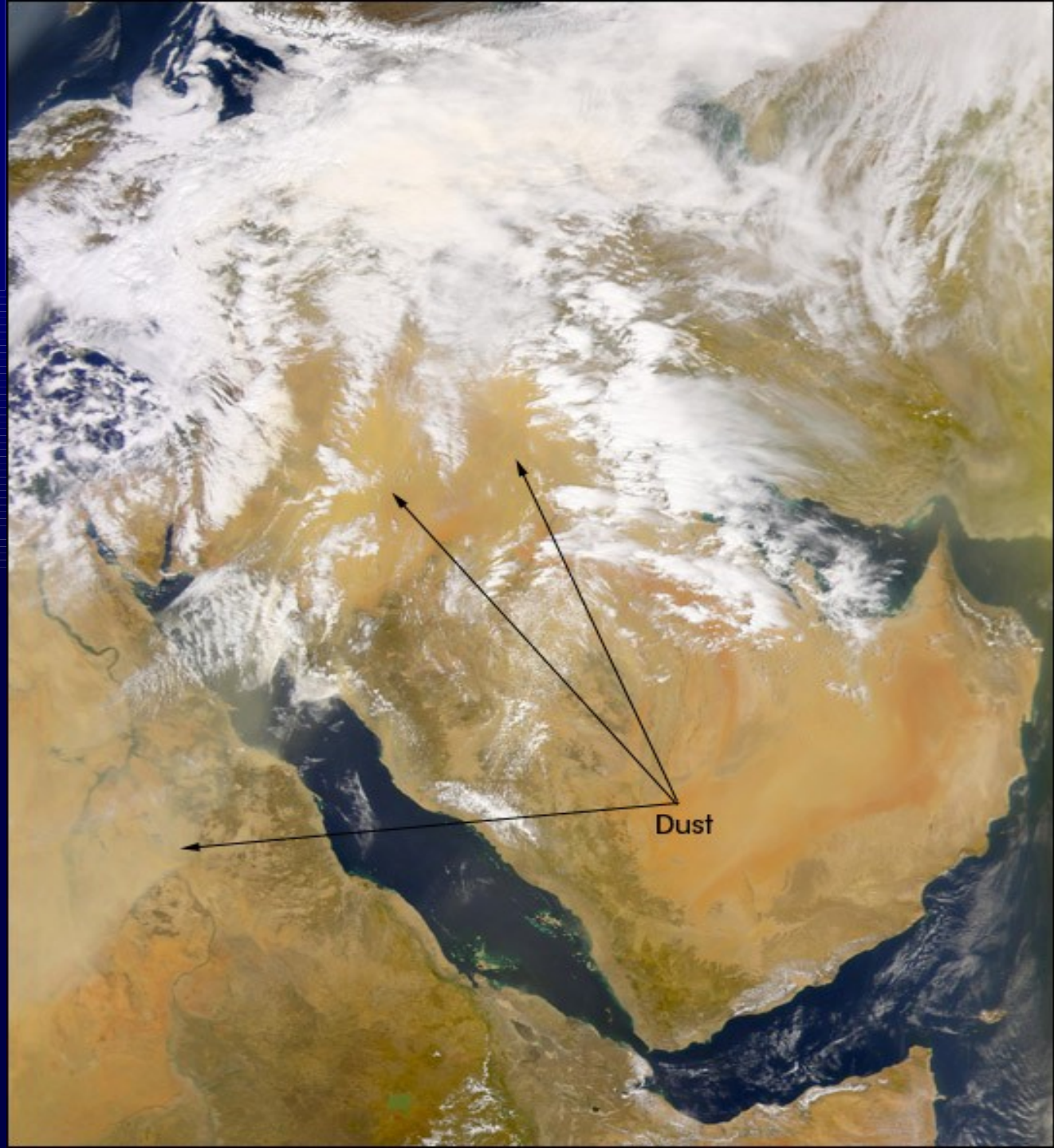
120mm DU Anti-tank
Long Rod Penetrator

Impact equivalent to
1.5 kg of TNT

Penetrator travels at
1.5+ km/sec

A-10 30mm DU Round Exit Hole, An Nasiriyah

Dust Storms over the Middle East



Not so depleted Uranium

Total Radioactivity Released by Uranium Weapons in the recent wars

Conflict	Mass (Tonnes)	Activity (Bq)
Chernobyl Reference		1.9×10^{18}
Gulf War I	350	1.3×10^{13}
Balkan Conflict	11	4.1×10^{11}
Afghanistan	1000 (estimate)	3.7×10^{13}
Gulf War II	1700 (estimate)	6.3×10^{13}
Total	**3061**	**1.3×10^{14}**

Signatures: The Ratio of Uranium Isotopes

	^{238}U	^{235}U	$^{238}U/^{235}U$	$^{235}U/^{238}U$
Natural Uranium	99.2739	0.7200	137.88	0.00725
Shrapnel (DU)	99.7945	0.2026	492.60	0.00203

The Unique Signature of Uranium Isotopes

	^{238}U / ^{235}U Ratio
Natural Uranium	137.88
Depleted Uranium	492.60

+ ^{236}U

The 15 Years of Radioactive Warfare

The UMRC Experience

Gulf War I & II

Iraq – Afghanistan - Balkans

Gulf War I Veterans

- The first group of DU contaminated patients was studied in 1991.
- Whole body and urine analysis suggested uranium contamination.

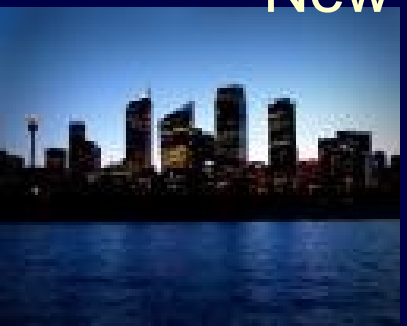
1998

Medical Effects of Internal Contamination With Uranium and Actinides

September, 1998 - New York City, USA

International Symposium on Low Level Radiation

New York Academy of Medicine



1999

Delayed Urinary Excretion of Uranium Isotopes in the Persian Gulf Veterans

June, 1999 - Opatija, Croatia

Third International Congress of the Croatian Society of Nuclear Medicine

1999

Medical Effects of Internal Contamination with Uranium

A. Durakovic

Croatian Medical Journal (CMJ), 40, 49-66, 1999

CROATIAN MEDICAL JOURNAL

1999

Urinary Excretion of Uranium Isotopes in the Gulf War Veterans After Inhalation Exposure to Depleted Uranium

July, 1999 - Dublin, Ireland

Eleventh International Congress of Radiation Research

2000

Urinary Excretion of Uranium Isotopes in British, Canadian and United States Gulf War Veterans

September, 2000 - Paris, France

European Association of Nuclear Medicine
EANM

2000

Human Data on Depleted Uranium Contamination in Gulf War Veterans

October, 2000 - Brussels, Belgium

Free University Brussels and Belgian Atomic Energy Commission Symposium

2001

On Depleted Uranium Gulf war and Balkan Syndrome

A. Durakovic

Croatian Medical Journal, 42,

373-377, 2001

2001

Chemical Forensic Detective Work: The Search for Depleted Uranium in Biological and Environmental Samples

May, 2001 - St. John's, Canada

Geological Association of Canada

Joint Annual Meeting


CHART OF THE NUCLIDES

2001

The Decade of Depleted Uranium

October, 2001 - London, England

The Royal Society

THE ROYAL SOCIETY

2002

The Quantitative Analysis of Depleted Uranium Isotopes in British, Canadian, and United States Gulf War Veterans

A. Durakovic, P. Horan, L. Dietz

Military Medicine, 167,

8:620-627, 2002

2002

Estimate of the Time Zero Lung Burden of Depleted Uranium in Gulf War Veterans by the 24 Hour Urinary Excretion and Exponential Decay Analysis

September, 2002 - Santiago, Chile

8th Congress of the World Federation of Nuclear Medicine & Biology

2003

Differential Decay Analysis of the Alpha Dose of Depleted Uranium and the Neoplastic Risk in the Lungs of Gulf War Veterans

June, 2003 - New Orleans

USA

Society of Nuclear Medicine 50th Annual Meeting

2005

Military Medicine April 05

The Quantitative Analysis of Uranium Isotopes in the Urine of the Civilian Population of Eastern Afghanistan after Operation Enduring Freedom

Asaf Durakovic MD, Ph.D., FACP

2005

May, 05 - Opatija, Croatia

The Bioassay of Uranium Isotopes in the Civilians of Baghdad and International Team Members After Operation Iraqi Freedom

and

Quantitative Analysis of Uranium Isotopes in the Civilians of Southern Iraq

FIFTH INTERNATIONAL CONGRESS
OF THE CROATIAN SOCIETY OF NUCLEAR MEDICINE

2006

- Dublin, Ireland
  9th World Congress on Environmental Health
- Kiev, Ukraine
  European Radiation Research Society
- Seoul, South Korea
  9th World Congress of Nuclear Medicine and Biology
- Athens, Greece
  Annual Congress of The European Association of Nuclear Medicine

Uranium Contamination in Afghanistan

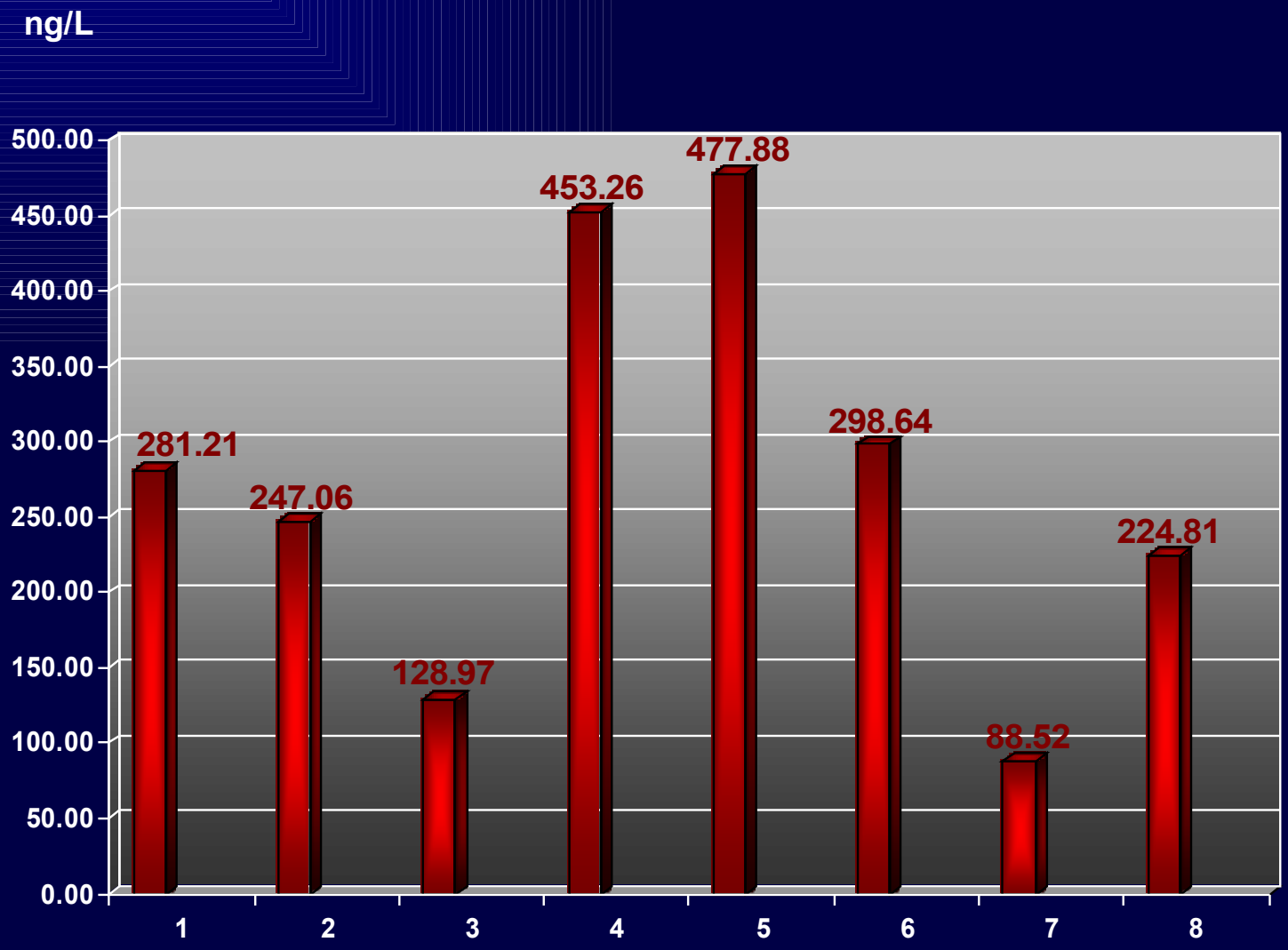
Afghanistan Field Trip 1: Jalalabad

Map of Afghanistan

Bomb Crater, Jalalabad, Afghanistan

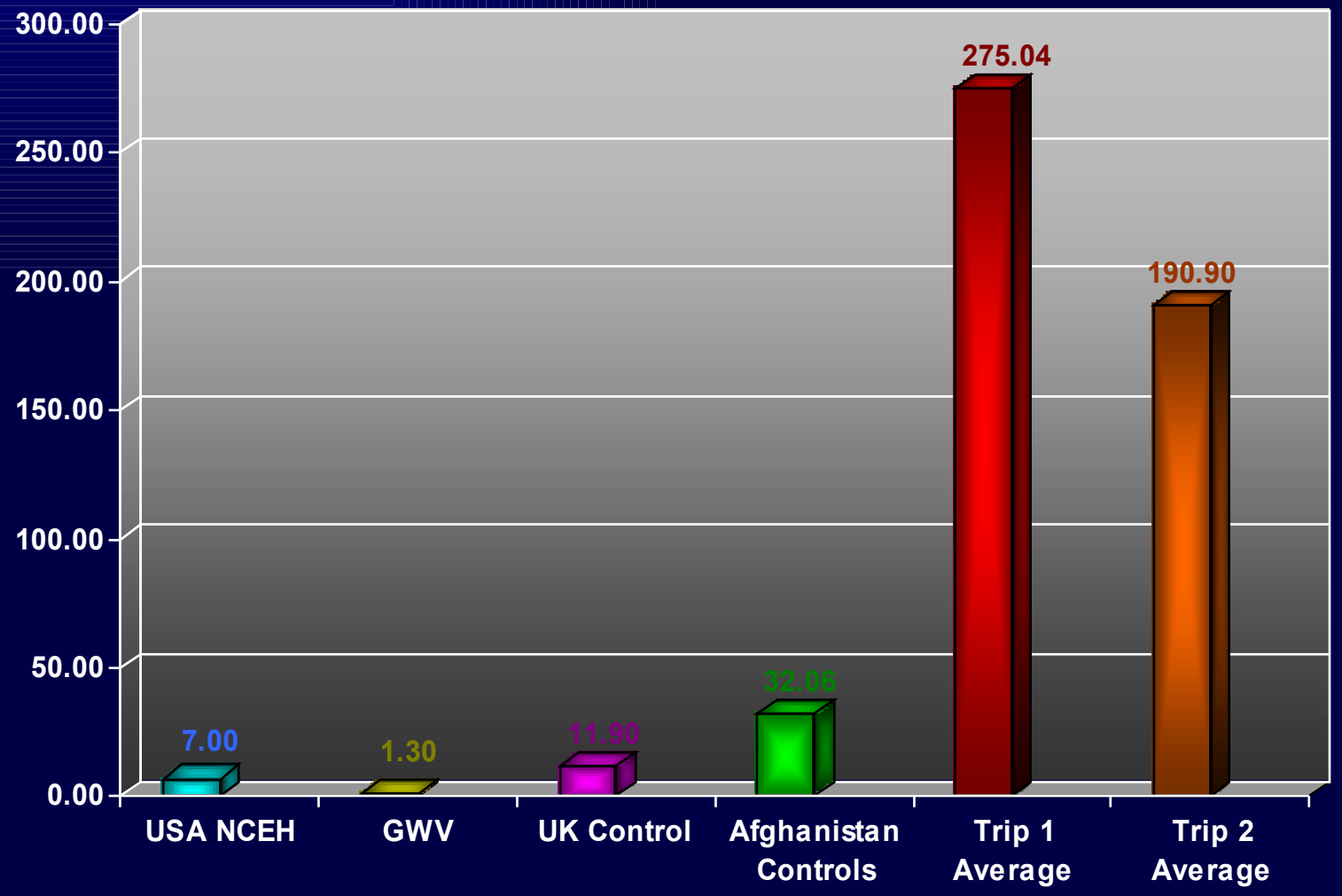
UMRC Team Member Gathering Soil Samples at Military Base

Afghanistan Trip 1: Jalalabad
Uranium Urine Concentration



Afghanistan Field Trip 2: Kabul

Comparison of Uranium Abundance in Urine



Gulf War II

Uranium Isotopes Contamination

Iraq war map


TURKEY
SYRIA
IRAN
NINAWA
SALAH AD DIN
AL ANBAR
Baghdad
WASIT
KARBALA
MAYSAN
AN NAJAF
AL MUTHANNA
KUWAIT
Kuwait
SAUDI ARABIA
JORDAN
Iraq
International boundary
Province (muḥāfaẓah) boundary
National capital
Province (muḥāfaẓah) capital
Expressway
Road
Railroad

Mass Spectrometry Laboratory

Institute of Mineralogy
JW Goethe University, Frankfurt, Germany

Iraq: Soil Samples

Isotopic Ratios:

Depleted uranium detected in 10 of 10 samples from tank battlefields and bomb sites

^{236}U detected in all samples

Uranium Concentration:

Concentration ranged from 0.1 - 1030 mg/kg

Iraq: Results
UMRC Field Team

Two of the three member UMRC field team tested positive for depleted uranium after returning after two weeks in Iraq.

Samawah: Gulf War II US Soldiers

- Depleted uranium detected in 4 of 9 samples
- ^{236}U detected in 7 of 9 samples

Lessons

Health care professionals are still inadequately trained in the basic radiation-toxicology of transuranium isotopes.

The psychological impact of the long term consequences of radiation exposure needs re-evaluation and consideration in the preparedness for future incidents.

A well-planned and coordinated inter-disciplinary research is urgently needed, addressing the current environmental and medical consequences of CBRN warfare.

… Lessons

An objective and unbiased approach to the role of nuclear and radioactive materials in the recent post-conflict unexplained illnesses is warranted.

It will provide further insight into the new concepts of the interdisciplinary research and medical science in CBRN anti-terrorism preparedness.

Survival of the Planet Earth

The biosphere is on the brink of irreversible catastrophe

“Then I saw a new heaven and a new earth, for the first heaven and the first earth had vanished and the sea was no more.”

Revelation

St.John of Pathmos

21/1

The Future

“Per correr miglior acque alza le vele
Omai la navicella del mio ingegno,
Che lascia dietro a sé mar sì crudele;

E canterò di quel secondo regno
Dove l'umano spirito si purga
E di salire al ciel diventa degno.”