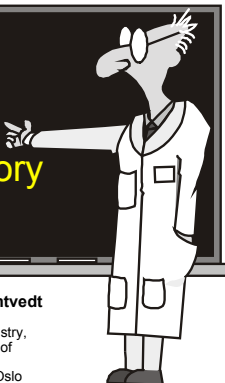


Introduction

(Tuesday 9-11)

Presentation & a small history lesson



Jon Petter Omtvedt

Nuclear Chemistry,
Department of
Chemistry
University of Oslo

KJM 5900 Autumn 2005

Jon Petter Omtvedt

KJM 5900 - Learning goals

- Understand what radioactivity is and why it's emitted.
- Basic understanding of the atomic nucleus.
- Understand radioactive disintegration.
- Be able to work safely with radioactive material.
- Be able to measure radioactivity.
- Be familiar with the most common uses of radioactivity.
- Be familiar with laws and regulations concerning radiation.
- Be able to evaluate the risks involved in radioactive work and arising from accidents.

KJM 5900 Autumn 2005

Jon Petter Omtvedt

What is radioactivity?

- Discuss with your neighbour!

KJM 5900 Autumn 2005

Jon Petter Omtvedt

Why is radiation dangerous?



- Chemical binding energies are of the order of eV (electron Volt).
- Radioactive radiation usually has energies in the keV and MeV ranges (i.e. 100 to more than one million times as much as a chemical bond).
- If such amount of energy is deposited in matter (e.g. a part of the body), a large amount of chemical bounds will be broken.

KJM 5900 Autumn 2005

Jon Petter Omtvedt

Er kurset farlig?



Nei!

KJM 5900 Autumn 2005

Jon Petter Omtvedt

Pregnant?

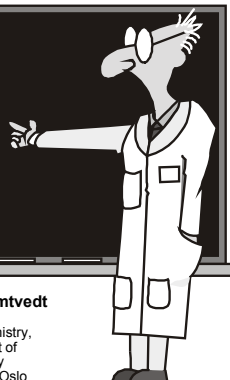
If you are pregnant please inform one of the teachers before attending the laboratory course.



KJM 5900 Autumn 2005

Jon Petter Omtvedt

Brief history



Jon Petter Omtvedt

Nuclear Chemistry,
Department of
Chemistry
University of Oslo

The famous history

- Radioactive radiation from uranium was discovered in 1896 by Becquerel.
- In 1898 Schmidt and M. Curie discovered similar radiation from thorium.
- Marie and Pierre Curie soon discovered the new elements Po and Ra, which was intensively radioactive.
- In 1899 Ernst Rutherford started to study the nature of the radiation and discovered that it consisted of three main types: α -, β -, and γ -radiation.
- Soon this exiting new research field exploded and lead to our current understanding of the atomic nucleus and the processes which are responsible for the radiation.

Professor Ellen Gleditsch (1879-1968)

- The young pharmacist Ellen Gleditsch was employed as assistant to prof. E. Bødtker in 1903.
- She soon showed her scientific qualities and was able to take her "PhD" in 1906, after much hard work.
- She then worked as associate professor until 1907.
- The exciting developments in the Curies laboratory draw her to Paris.
- The french laboratories was crowded, but Bødtker was able to convince M. Curie that his assistant was worthy and that she "was so small she would hardly occupy any laboratory space". Beside this, Curie needed a chemist.



Ellen Gleditsch, Student 1902

Gleditsch, early years

- Gleditsch came to Paris late in 1907, where she initiated a lifelong, personal friendship with M. Curie.
- In Paris Gleditsch proved her worth and made significant scientific contributions. She stayed for five years, until 1912.
- She was now the definitive authority on radioactivity in Norway.
- In order to continue her research, she went to Prof. Boltwood at Yale University in 1913 to 1914 (the equipment in Oslo was grossly inadequate).



Gleditsch in 1929

The fundation of Nuclear Chemistry in Oslo

- When she came back to Norway, Gleditsch was employed in a new position in radiochemistry at the University of Oslo in 1916.
- She created and lead an active group of researchers in nuclear chemistry, and lay the foundations for all future nuclear chemistry work in Norway.
- In 1929 she was appointed to the professorship left after Goldschmidt. Thus, she also became the leader of the section for Inorganic Chemistry. She was the second female professor in Norway.
- She formally retired in 1946, but was active many years after that - she gave her last talk in 1967, at an age of 88 years!



Gleditsch gets a honorary doctorate at La Sorbonne in 1962.

Nuclear Reactors and IfA

- After WWII much of the Norwegian infrastructure needed to be rebuilt. This was specially true for science and technology - the corner stones of the modern society Norway wished to become.
- In 1945 a committee led by the astro-physicist Gunnar Randers was established to investigate the possibilities given by nuclear reactors.
- In 1947 funding was approved by the government and the *Institute for Atomic Energy (IfA)* was created.
- However, to construct the reactor exceptional talent and practical skill was needed.
- Fortunately, Norway had such a man: *Odd Dahl*.



Randers and Einstein

Odd Dahl



- Born in 1899, Odd Dahl became one of Norway's most admired scientists.
- He did not have any "classical" education as a scientist, but was mostly self educated.
- In 1922-25 he participated in Roald Amundsen's exploration of the arctic. He enrolled as a pilot, but soon showed his talents in a variety of other fields. In his spare time aboard Maud he read physics.
- After the Maud-expedition he worked at the Carnegie Institute of Technology in Washington. He stayed in the US for 10 years and came back to Norway as a distinguished and well-known scientist.
- In Norway, he worked at the Christian Michelsen Institute (CMI) in Bergen. Under the influence of Dahl the main activity at CMI became science and technology.

KJM 5900 Autumn 2005

Jon Petter Omtvedt

JEEP I



From the start-up of JEEP I in 1951

- Thanks to the exceptional engineering and scientific abilities of Dahl, Randrup's dream became true: The JEEP I nuclear-research reactor went critical on the first try in 1951.
- Norway was the sixth country which built a nuclear reactor (after USA, UK, USSR, France and Canada).
- Many obstacles had to be overcome in order to get uranium for the reactor (many of them were created by the US), finally Norway got uranium from the Netherlands.

KJM 5900 Autumn 2005

Jon Petter Omtvedt

Alexis C. Pappas

→ When Gleditsch gradually stepped down her teaching at the University of Oslo, one of her brightest pupils took her place: Alexis C. Pappas.

- Pappas was employed as scientific assistant to Gleditsch between 1941-47.
- He worked in Paris in 1948 and 49.
- After that, he returned to the University of Oslo.
- He worked at the Massachusetts Institute of Technology in Boston between 1949 and 51.
- Pappas was given a professorship in radiochemistry from the National Cancer Society in 1957.
- In 1962 he was employed by the University as professor in nuclear chemistry.



KJM 5900 Autumn 2005

Jon Petter Omtvedt

Pappas' work

- Pappas nuclear chemistry group in Oslo was highly regarded and educated a huge number of both Norwegian and foreign students. At the most intense, more than 30 students were working in Oslo.
- Pappas played a major part in the international collaboration to build CERN in Geneva.
- He and prof. Rudstam (Uppsala University) were the main forces behind the then unique ISOLDE project at CERN for studying nuclei far from stability.



Picture from the celebration of Pappas' 60 years birthday.

KJM 5900 Autumn 2005

Jon Petter Omtvedt

The "glory" of nuclear energy fades...

- The enthusiasm about nuclear energy faded in the 70's.
- For a land generously provided with ample amounts of hydro power, it was easy for the politicians to abandon nuclear energy to please the voters.
- At the same time oil was discovered below the sea outside the Norwegian coast and the politicians decided that "Norway will not use nuclear energy in the foreseeable future".



KJM 5900 Autumn 2005

Jon Petter Omtvedt

IfE - the Institute for Energy research

- As it became evident that Norway would not exploit nuclear energy, IfA went through a major reform to survive.
- In 1980 it changed name to "the Institute for Energy research" (IfE) and started to employ its considerable engineering and scientific expertise to participate in developing installations in the North Sea.
- Today IfE has major national and international projects for the petroleum industry. Many projects use nuclear methods, e.g. tracers, to achieve its goals.
- In addition, IfE continues its highly regarded international research on reactor technology and safety.

KJM 5900 Autumn 2005

Jon Petter Omtvedt

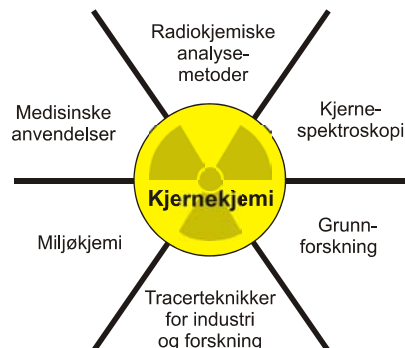
Sources

- T. Kronen and A.C. Pappas: "Ellen Gleditsh", Aventura 1887, ISBN 82-588-7145-5.
- Proceedings to Symposium "Aspects of Nuclear Science - In Honour of Prof. A. C. Pappas", Ed. E. Hagebø and B. Salbu, Norwegian University Press, 1985, ISBN 82-00-18343-2.
- F. Lied, J. Ofstad, T. Gjelsvik, J.C. Hauge: "En av Norges store sønner", Aftenposten 23. June, 1994.
- Prof. Jorolf Alstad - private communication 2001.
- Prof. Tor Bjørnstad - private communication 2001.
- Prof. Einar Hagebø - private communication 2001.

KJM 5900 Autumn 2005

Jon Petter Omtvedt

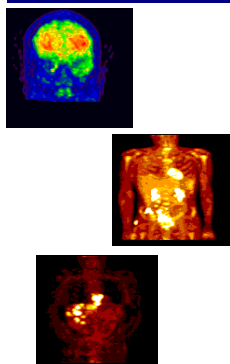
Dagens kjernekjemi



KJM 5900 Autumn 2005

Jon Petter Omtvedt

Medisinske anvendelser



- Radioaktivitet kan benyttes til diagnose og behandling.
- Arbeidet ved kjernekjemi i Oslo har vært spesielt rettet mot behandling av kreft ved injeksjon av α -kilder (^{211}At).
- Et nytt PET-senter bygges opp ved Rikshospitalet i Oslo. Omfattende forskning på radioaktive legemidler vil bl.a. bli gjort ved kjernekjemi.

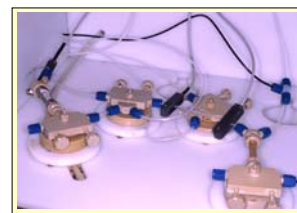
Prosjektleder og veileder:
Per Hoff og Gjermund Henriksen(?).

KJM 5900 Autumn 2005

Jon Petter Omtvedt

Studier av nye og ukjente grunnstoff

- Væske-væske ekstraksjon i spesialbygde sentrifuger benyttes til å undersøke de kjemiske egenskapene til "verdens tyngste" grunnstoff - transaktinidene ($Z > 103$).
- Syklotronen ved Fysisk Institutt benyttes for utviklingsforsøk.
- Eksperimenter utføres bland annet i Berkeley, USA og i Darmstadt, Tyskland.
- Gruppen i Oslo inngår som en del av en stor internasjonal kollaborasjon.



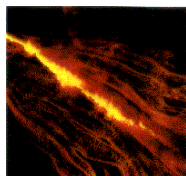
Veileder og prosjektleder:
Jon Petter Omtvedt
www.kjemi.uio.no/kjernekjemi/

KJM 5900 Autumn 2005

Jon Petter Omtvedt

Bruk av radioaktive tracere i oljeindustrien

- Tracerteknologi brukes av oljeselskaper verden over for maksimal utnyttelse av oljereservoarer.
- Oppgaver tilbys i tilknytning til utvikling og forbedring av metoder for oljeleting og oljeutvinning ved bruk av radioaktive tracere.



Veiledere:
Jon Petter Omtvedt (UiO)
Tor Bjørnstad (IFE)

Samarbeidsprosjekt med Institutt for Energiteknikk **IFE**

KJM 5900 Autumn 2005

Jon Petter Omtvedt

Hva gjør kjernekjemikere?



- Stor variasjon i valg av arbeidsplass etter master:
 - ▶ IFE på Kjeller og i Halden.
 - ▶ Sykehus.
 - ▶ Statens Strålevern.
 - ▶ Offentlig forvaltning.
 - ▶ Programmeringsjobber.
 - ▶ Skoleverket.
 - ▶ Private bedrifter.
- Kjernekjemikere som har startet egne firma:
 - ▶ Laborel AS.
 - ▶ Axis-shield.
 - ▶ Studsvik rad-waste.
 - ▶ ATI AS (Anti-cancer Therapeutic Inventions).
- Mange går videre med PhD:
 - ▶ På Blindern.
 - ▶ Ved utenlandske institusjoner.



KJM 5900 Autumn 2005

Jon Petter Omtvedt

Blir kjerne kjemi og kjernefysikk **SAFE**?

Senter for **A**kseleratorbasert **F**orskning og **E**nergifysikk.

- Kjernefysikk og kjerne kjemi blir slått sammen til en enhet som bruker kjerneforskningsteknikker til å studere problemer innen:
 - Kjernestruktur
 - Radiokjemiske analysemetoder
 - Studier av de supertunge grunnstoffene
 - Tracerteknikker for bruk i industrien (spesielt oljeindustrien)
 - Medisinske anvendelser (PET)
 - Energifysikk
- Spennende og tverrfaglig studiemiljø, med felles kollokvier og faglige aktiviteter.

Følg med på: www.safe.uio.no

Helt SAFE