

Brachytherapy - an Overview

Yakov Pipman, D Sc
North Shore LIJ Health System

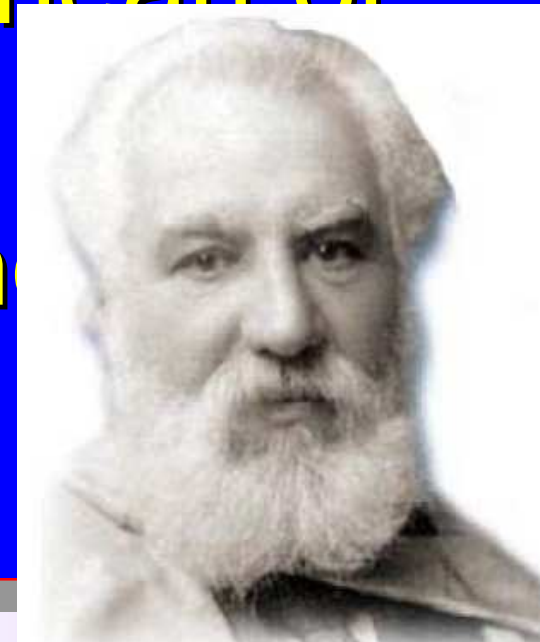
Monterrey, Nov30-Dec1, 2007



Brachytherapy

- **A procedure in therapeutic radiology that involves the irradiation of a target with radioactive sources placed at short distances from the target**

“...there is no reason why a tiny fragment of radium sealed up in a glass tube should not be inserted into the very heart of the cancer; thus acting directly upon the diseased material.”

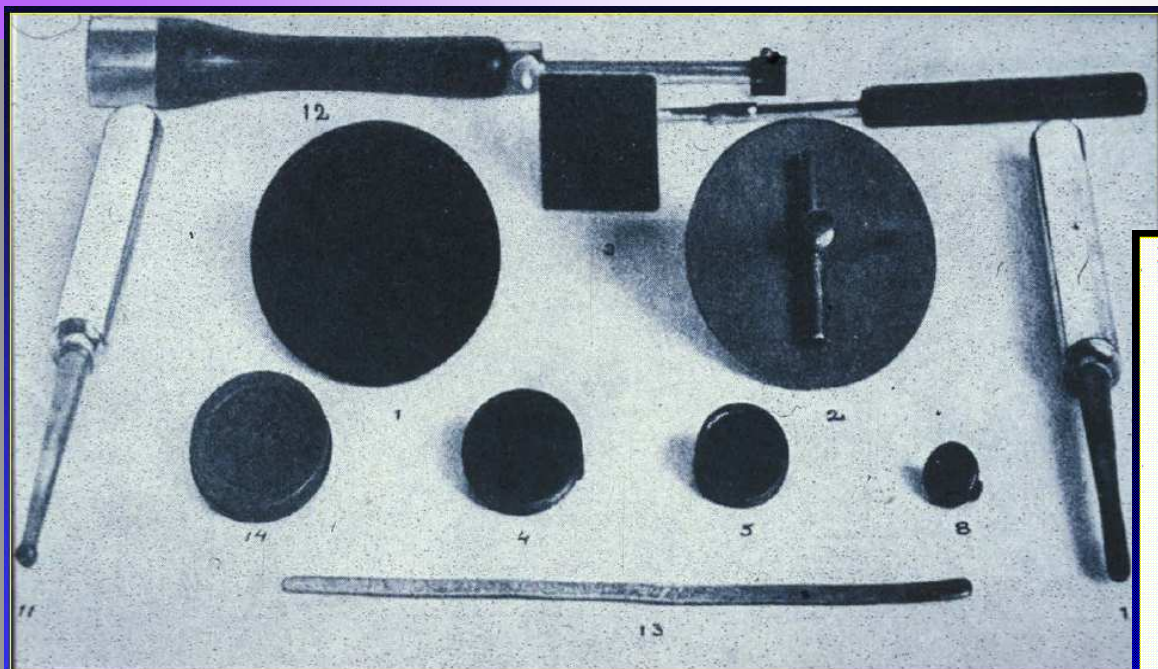


A.G. Bell

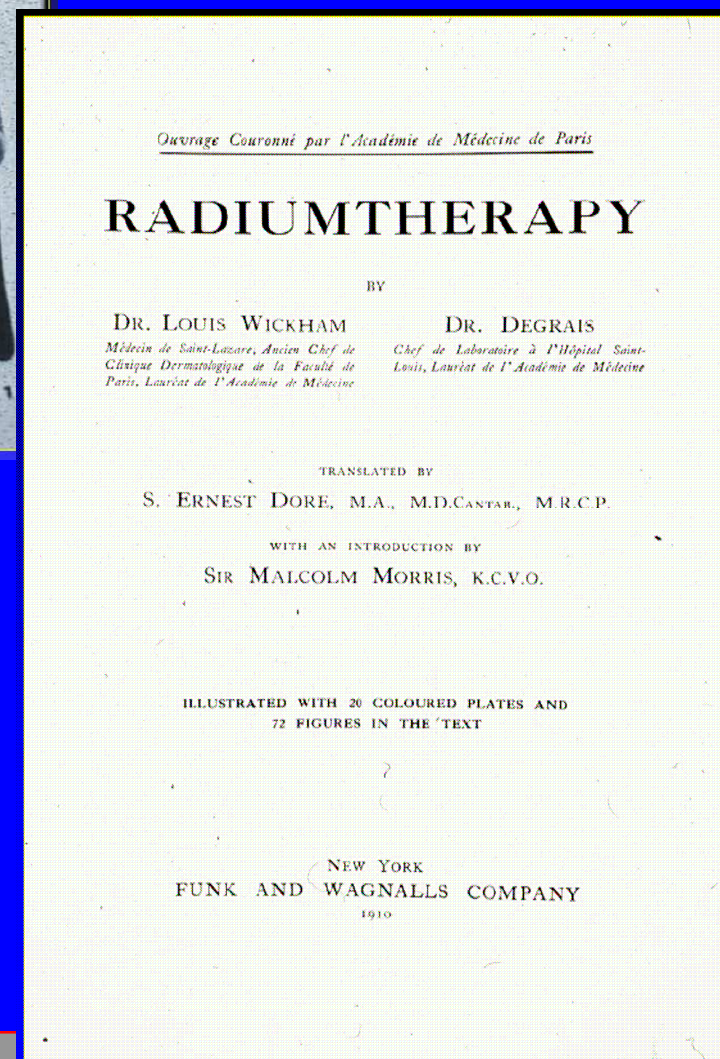
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Radium applicators for
surface and intracavitary
applications,
used by Danlos and later
by Wickham.



- Takes advantage of the Inverse Square Law
Why BRACHYTHERAPY ?
- Easy to deliver High Dose to Limited Volume
- Differential Effect of High Dose Rate on Tumor & Normal Tissues

BRACHYTHERAPY **can be highly CONFORMAL**

**Conforms (high) dose to the target
volume for improved tumor control**

**Conforms (low) dose to
sensitive structures to reduce
complications**



So, what is new in Brachytherapy?

- **Many new organs and conditions treated, some experimentally.**
- **Proliferation of new applicator designs to improve geometric conformance to anatomy and to address clinical situations.**
- **New materials compatible with new imaging modalities to better identify targets. (CT, MR and US)**
- **Better dose optimization and computation speeds allow interactive planning**
- **New Isotopes to address issues of protection, of dosimetry and of dose rates.**
- **New technical developments to replace isotopes with electronic sources.**
- **Shift to HDR or permanent implants, to outpatient procedures and to shorter treatment schedules**



Variables used in the Characterization of Brachytherapy Treatments

- **Time**
- **Geometry**
- **Source placement**
- **Loading Method**
- **Dose Rate**

...by the Length of Treatment Time:

- **Temporary**

- *Typically using a Long Half-life isotope*
- *Breast, GYN, prostate, brain, lung, Head and Neck, Sarcomas, Intraoperative, superficial molds*

- **Permanent**



- **Point**

- MammoSite
- GlinSite

- **Linear**

- Vaginal Cylinder
- Intravascular
- Bronchial

- **Planar**

- Superficial Mold
- Eye plaques
- Intraoperative applicators
- Breast

- **Volume or multiplanar**

- Prostate
- Breast
- Brain
- Syed Implants

- **Applicator**

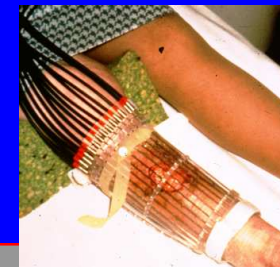
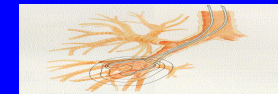
- GYN
- Breast
- Beta eye applicator for pterygium

by the Geometry

Source Access or Placement



- **Interstitial - Implanted in the target tissue directly**
- **Intracavitary - Placed inside body cavities and treating target tissue to distances of the order of several millimeters or even centimeters**
- **Intraluminal – Subcategory of Intracavitary, where the source does into the lumen of a vessel or**

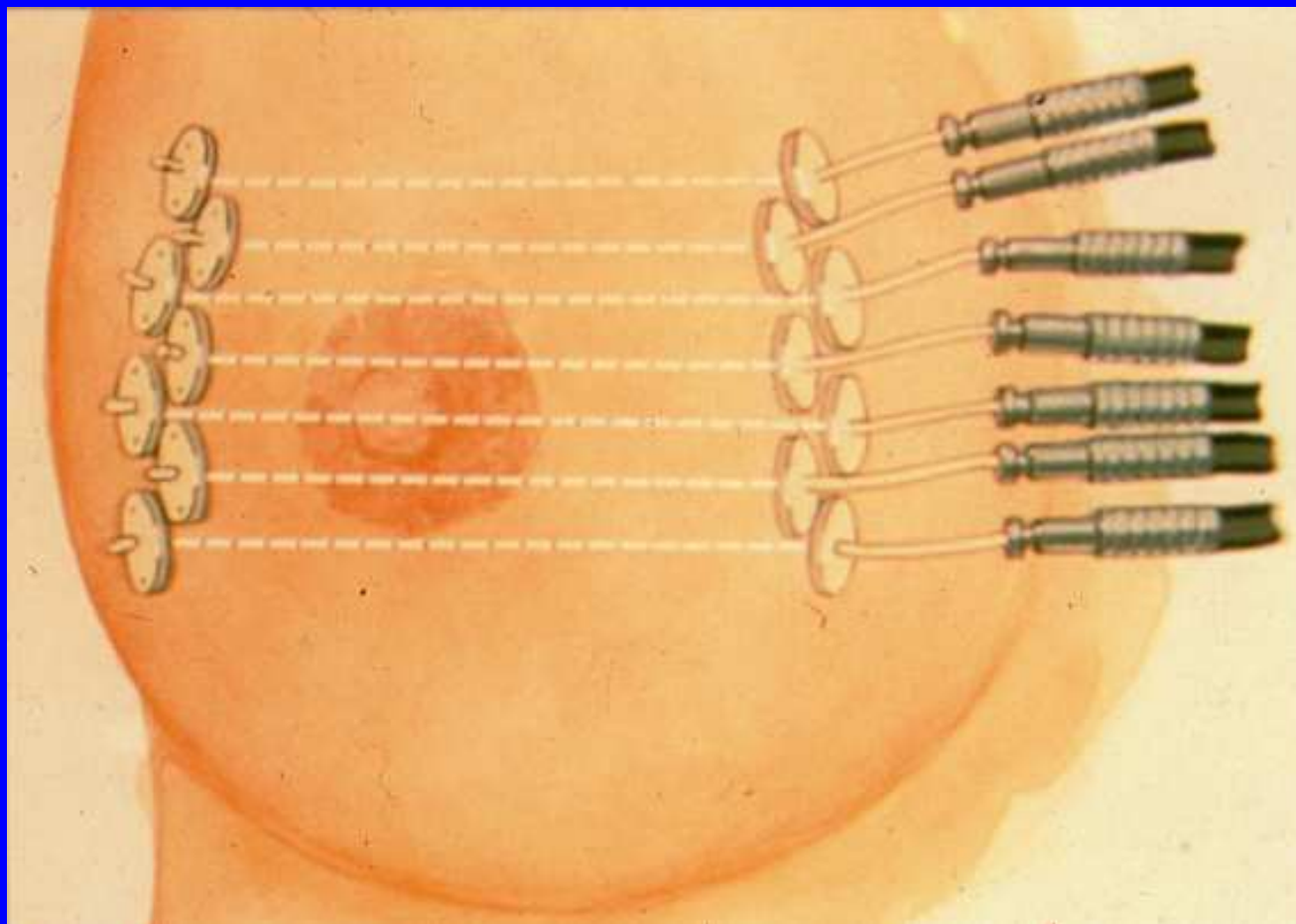


APPLICATIONS OF HDR-RA WITH BUILT-IN SIMULATOR SOURCE

**Intraluminal
Interstitial
Intracavitary
Intraoperative**



APPLICATIONS OF HDR -RA



Interstitial breast implants

APPLICATIONS OF HDR -RA



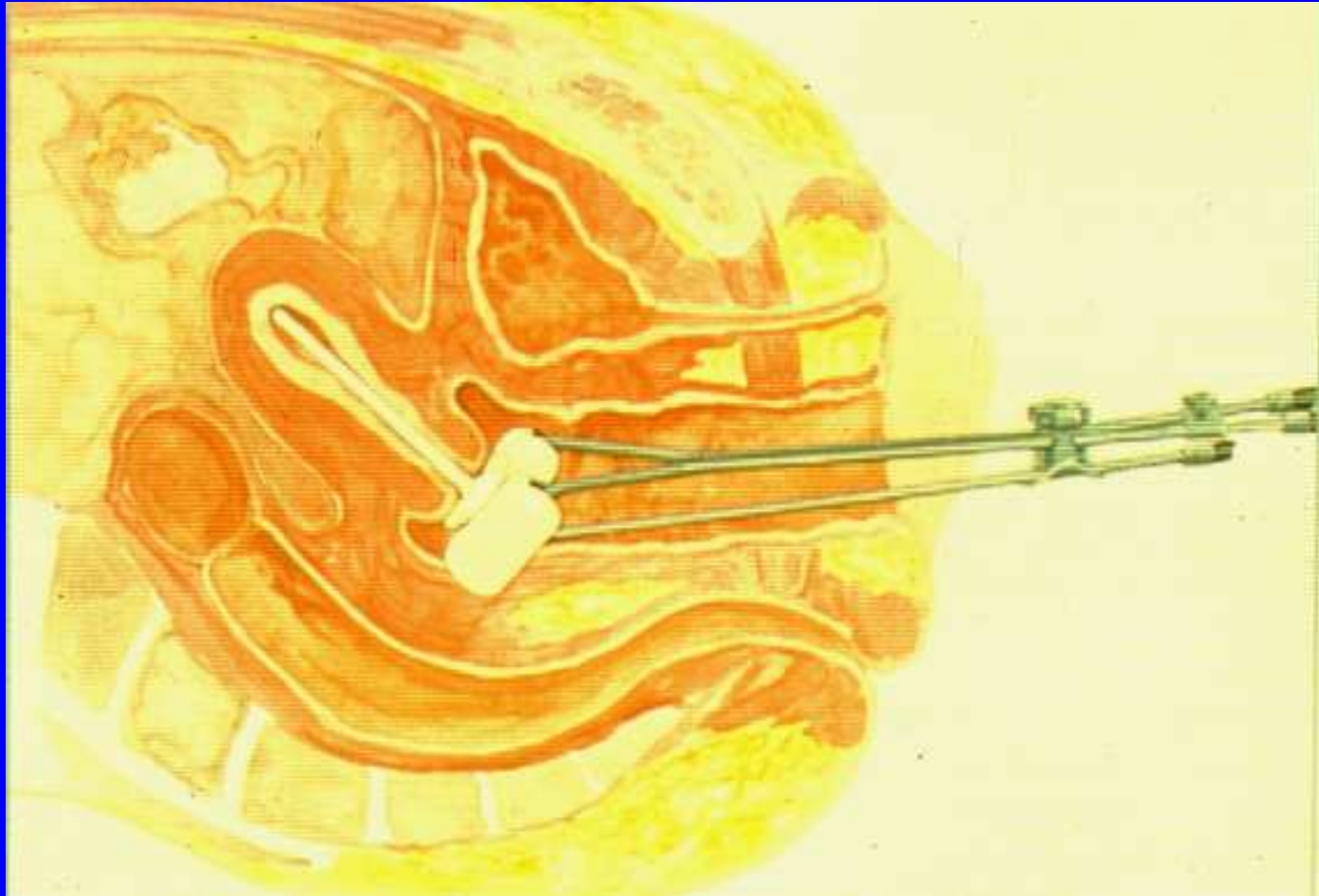
Interstitial volume implant of the Prostate

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APPLICATIONS OF HDR -RA



Intracavitary application of Cervix Brachytherapy

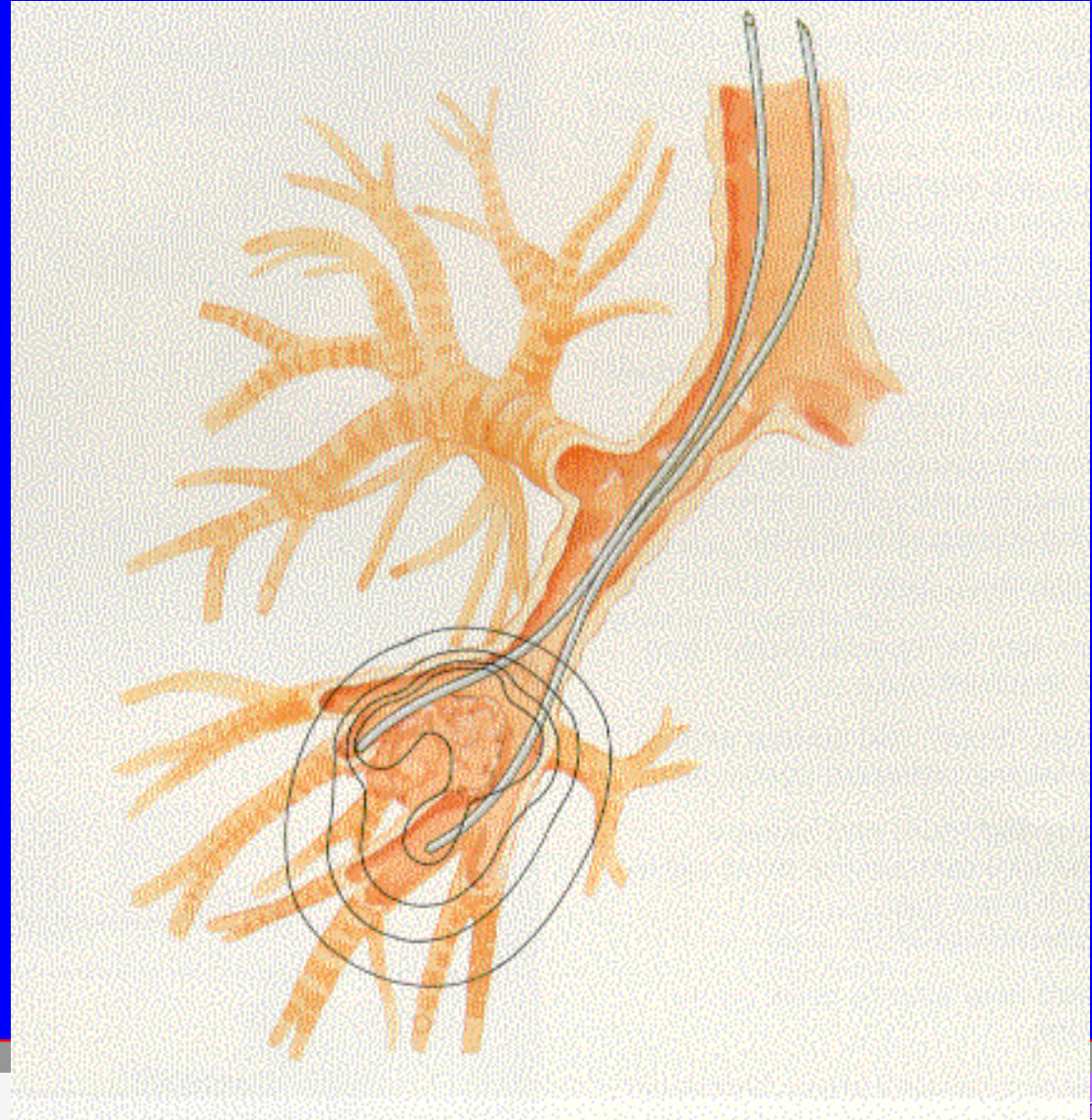
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APPLICATIONS OF HDR -RA

Intraluminal lung treatment

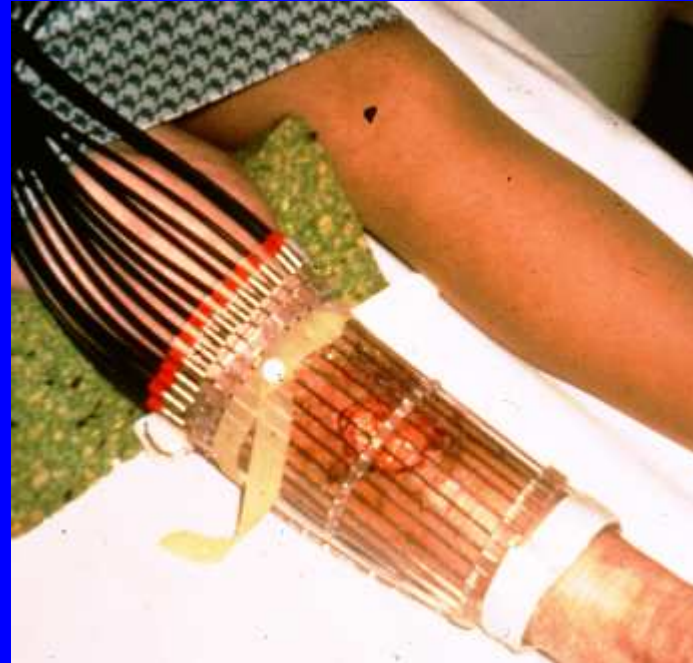


Surface Mold application for highly irregular superficial lesion



APPLICATIONS OF HDR

Planar Mold and Intraoperative applicators



- **Immediate or live**
 - *Seeds*
 - *Seeds in Suture*
 - *Surface applicators – (Beta or Low Energy)*
- **Afterloaded – manually**
 - *Fletcher or Henschke - always LDR*
 - *GliaSite, Microspheres*
- **Afterloaded – remotely**
 - *LDR, MDR, HDR, PDR*

..by the Number of Sources:

- **Multiple (static)**
 - Prostate seed implant
 - LDR Syed, LDR base of tongue, LDR for sarcomas, etc.
 - GYN applicators – LDR, manual or remote

- # According to Dose rate (ICRU 38)
- **Low: 0.4 to 2.0 Gy per hour [LDR]**
 - permanent and manually loaded
 - typical treatment times of 3 to 5 days
 - Requires hospitalization
 - Longest experience
 - **Medium or Intermediate: 2 to 12 Gy per hour [MDR]**
 - Higher risk for manual loading
 - In-patient
 - **High: More than 12 Gy per hour [HDR]**
 - Remote afterloaded - No personnel exposure
 - Typical treatment times several minutes
 - Outpatient procedure in most applications
 - Uses very high activity sources (typically a 10 Ci ^{192}Ir)
 - Used in well-shielded room. (1-2 ft concrete for Ir-192)
 - Significant experience
 - **Pulsed [PDR]**
 - Total treatment duration like LDR
 - Source exposed in pulses for 5 to 10 minutes in each hour.

Anatomic sites amenable to Brachytherapy treatment:

GYN

Breast

Prostate

Rectum

Head and Neck

Extremities

Superficial lesions

Intraoperative sites

Lung

Skin

Eyes

Blood vessels

Liver

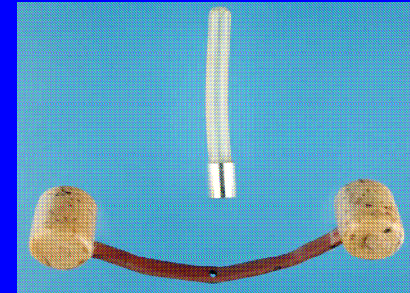
Heart



CARCINOMA of the CERVIX

Intracavitary Systems

Paris →



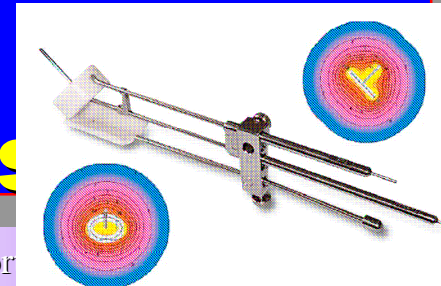
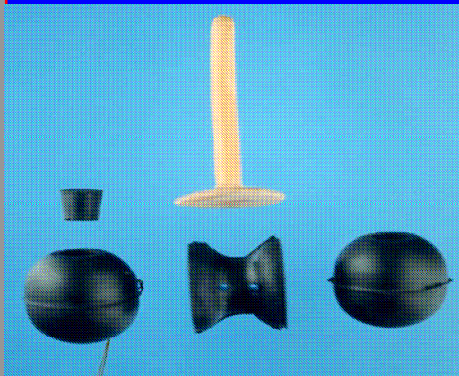
Stockholm

← **Manchester**

MD Anderson

**Mallinckrodt Institute of
Radiology**

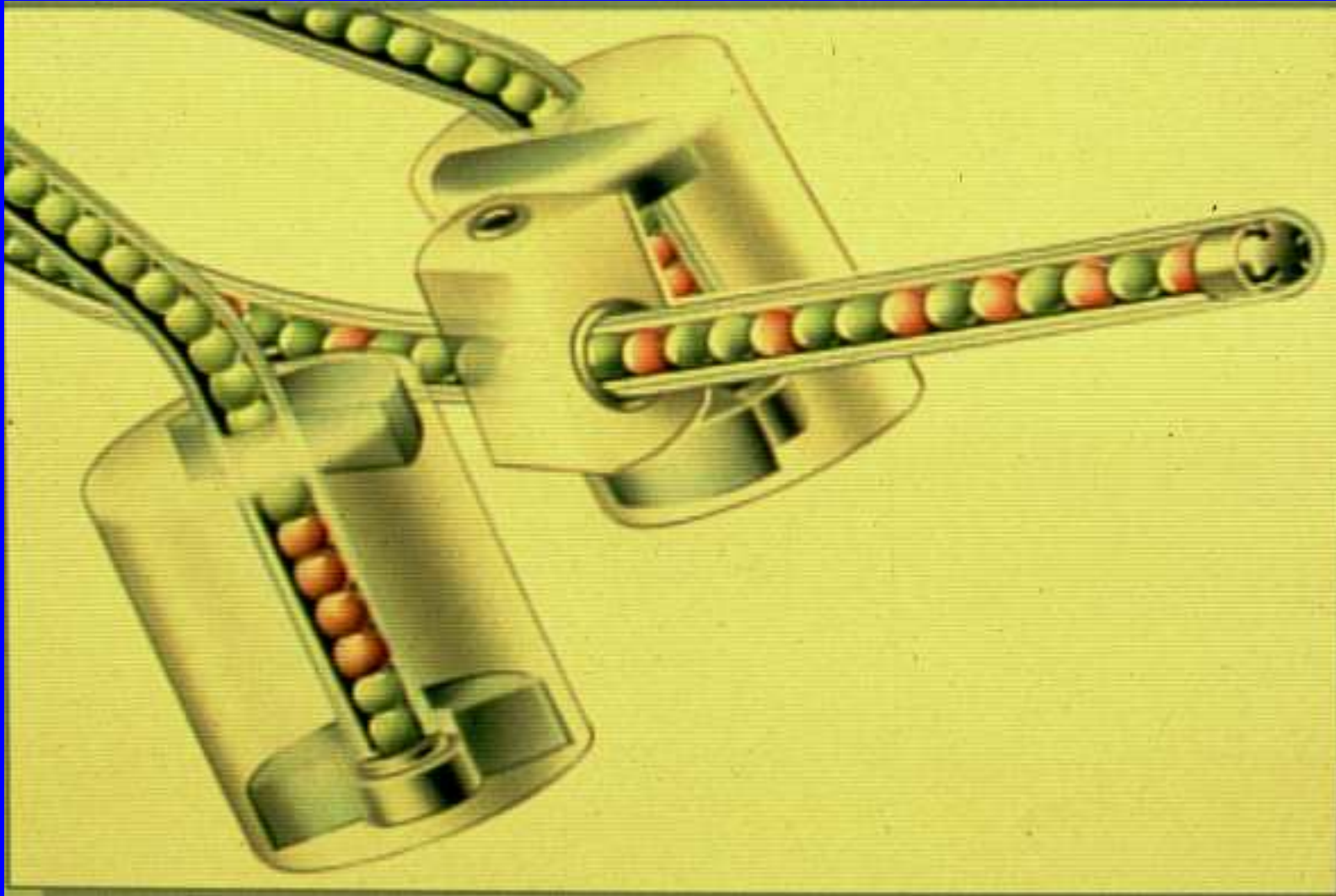
CT/MR 3D Systems



LDR AFTERLOADER

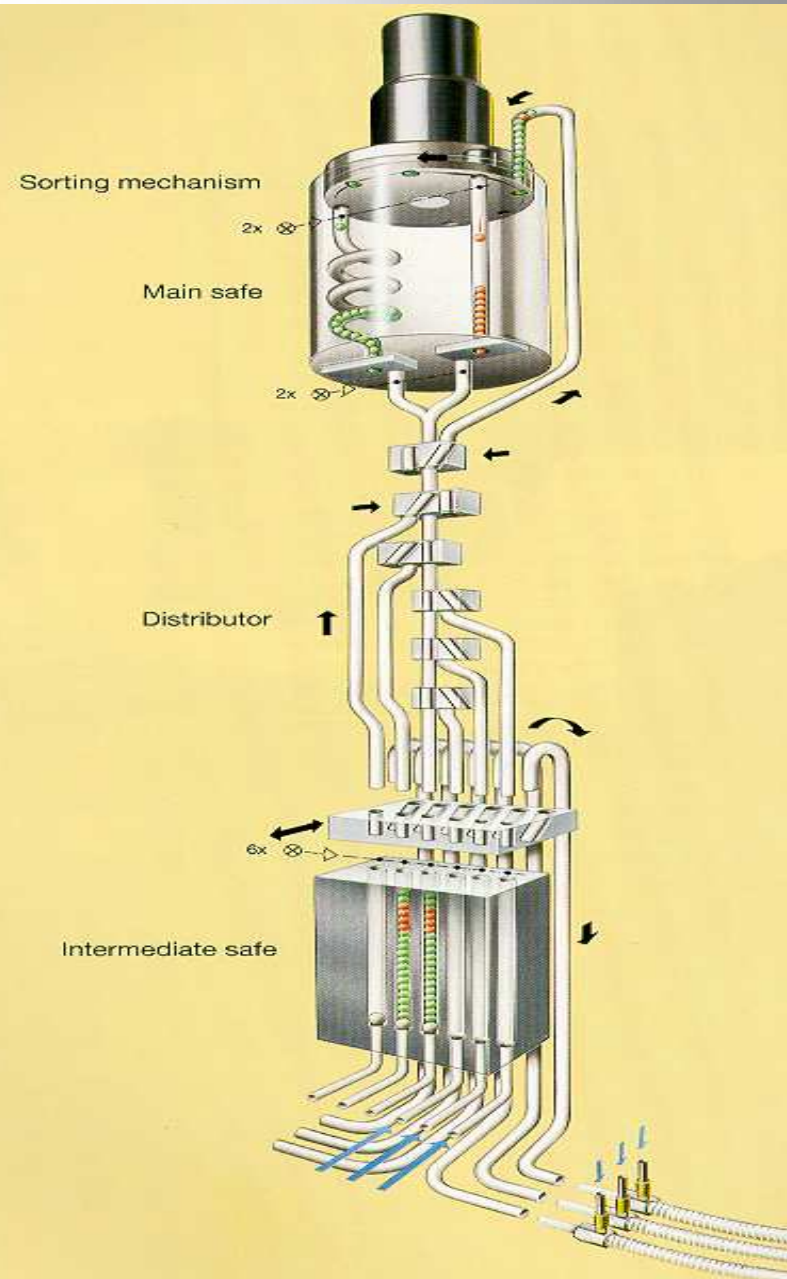


LDR Cs-137 Sources and Applicator

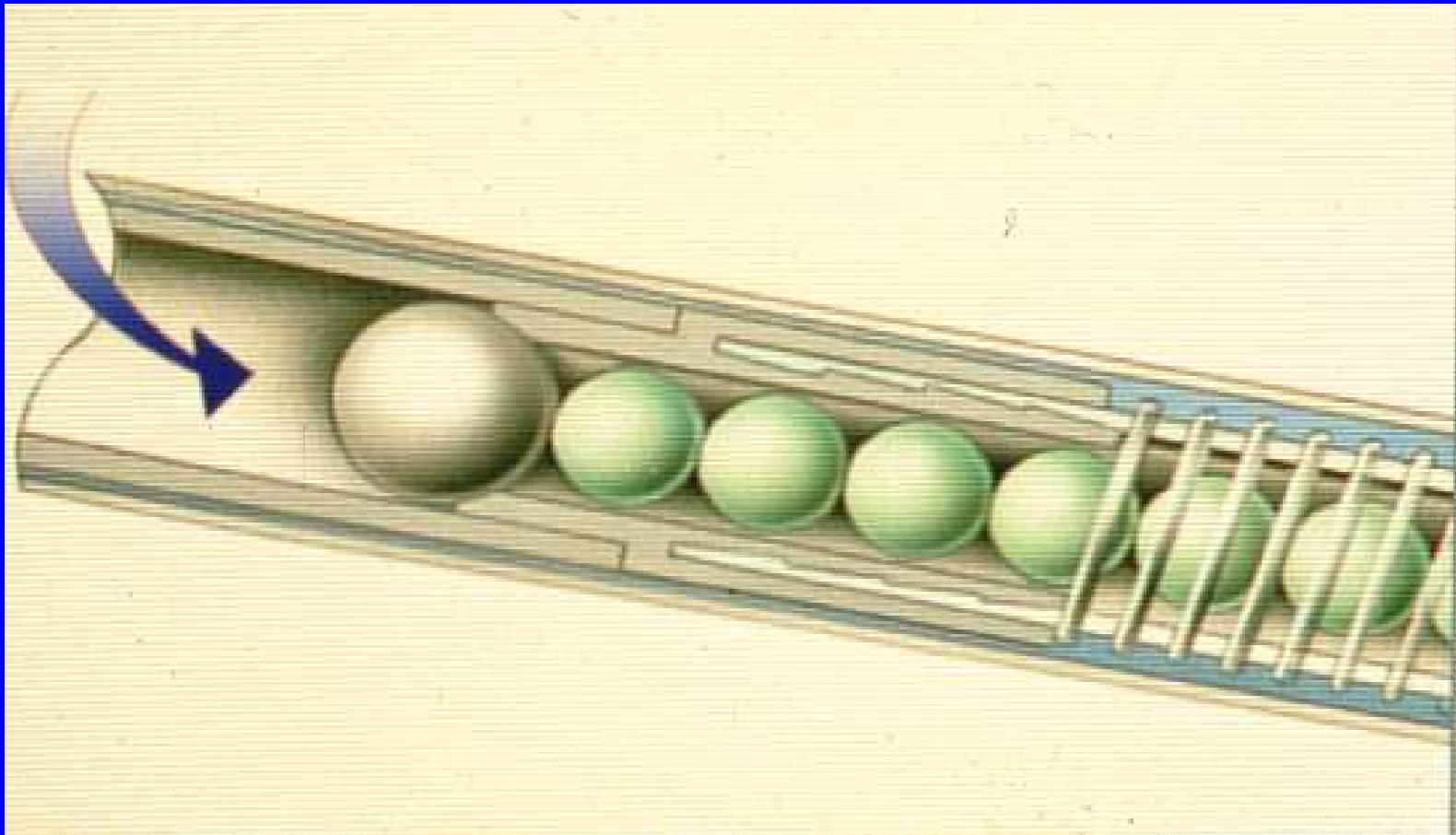


LDR AFTERLOADER

Operation



LDR Cs-137 Source Location system



“Classic”

**© HDR
unit**



HDR Source Driving system





HDR unit and source cable



Objectives

- Guidance to facilitate establishing a program
- Key components to commission a remote afterloading system
- Review some techniques used in Brachytherapy
- Learn the Radiobiological tools and considerations to shift among modalities
- Estimate the effort/resources required

