放射技師可否獲取諾貝爾獎?
Can radiological technologists win the Nobel Prize?

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1. BACKGROUND
背景

1. Background

- There are fewer research studies in radiography .than in other disciplines.
- Are we happy with the present?
- Can we take a step further to raise our profile?
- Do we think outside of our own box for something more innovative?
- Dare we think that we can win the Nobel Prize?

- 放射專業的研究項目比其他專業來得少.
- 我們滿足於現況嗎?
- 我們可否再進一步提升呢?
- 我們有否跳出自己的框架去思考一些創新的事物?
- 我們有否胆量去想像有一天我們能拿取到諾貝爾獎呢?

2. THE NOBEL PRIZE
諾貝爾獎

2. The Nobel Prize

- Starting 1901, the Nobel Prize has been awarded for achievements in physics, chemistry, physiology/medicine, literature, and for peace.
- What has the Nobel Prize to do with radiological technologists? Is this something attainable by our profession?

- 諾貝爾獎始於1901年, 為獎勵在物理學, 化學, 生理學/醫學, 文學及在締造和平上曾作出重大貢獻者.
- 諾貝爾獎與放射技師有何關係? 為我們的專業而言, 它是否遙不可及的呢?

3. NOBEL PRIZES RELATED TO MEDICAL RADIATION SCIENCES
與醫療放射有關的諾貝爾獎

1901
First Nobel Prize in Physics

For discovery of the remarkable X-rays (Rontgen rays) in 1895 **[發現X射線]**

Wilhelm Conrad Röntgen
1845-1923
Awarded at age 56

1903
Nobel Prize in Physics

For discovery of radioactivity by Becquerel in 1896
［發現輻射性活動］

Antoine Henri Becquerel
1852-1908
Awarded at age 51

Pierre Curie
1859-1906
Awarded at age 44

Marie Curie, née Sklodowska
1867-1934
Awarded at age 36

Pierre and Marie Curie in the "hangar" at l'Ecole de physique et chimie industrielles in Paris, France, where they made their discovery

1908
Nobel Prize in Chemistry

For investigations into the disintegration of the elements and the chemistry of radioactive substances. Some atomic nuclei were found to be unstable and could emit the α, β or γ radiation observed.［研究元素的蛻變及放射物質的化學性］

Ernest Rutherford
1871-1937
Awarded at age 37

1911
Nobel Prize in Chemistry

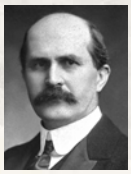
For discovery of radium and polonium
［發現鐳及釙］

Marie Curie, née Sklodowska
1867-1934
Awarded at age 44

1915
Nobel Prize in Physics

For their services in the analysis of crystal structure by means of X-rays［用X射線對晶體結構的分析］

William Henry Bragg
1862-1942
Awarded at age 53



← Father & son →

William Lawrence Bragg
1890-1971
Awarded at age 25

1927
Nobel Prize in Physics

Divided equally between Arthur Holly Compton and Charles Thomson Rees Wilson:

for Compton's discovery of the effect named after him [康普頓效應]

for Wilson's invention of the cloud chamber, also named after him as Wilson Chamber for detecting particles of ionizing radiation [發明雲室,又稱為威爾遜雲室, 用來偵測游離輻射粒子的儀器]

Arthur Holly Compton
1892-1962
Awarded at age 35

Charles Thomson Rees Wilson
1869-1959
Awarded at age 58

1939
Nobel Prize in Physics

for the invention and development of the cyclotron 1929 and for results obtained with it, especially with regard to artificial radioactive elements [發明回旋加速器及它的應用]

Ernest Orlando Lawrence
1901-1958
Awarded at age 38

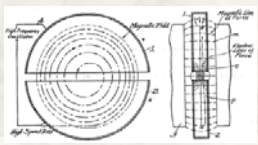


Diagram of cyclotron operation from Lawrence's 1934 patent

Source: Website

1977
Nobel Prize in Physiology / Medicine

One half jointly to Roger Guillemin and Andrew V. Schally "for their discoveries concerning the peptide hormone production of the brain" and
the other half to Rosalyn Yalow for the development of radioimmunoassays (RIA) of peptide hormones [开发多肽类激素的放射免疫分析法].

Roger Guillemin
Born in 1924
Awarded at age 53

Andrew V. Schally
Born in 1926
Awarded at age 51

Rosalyn Yalow
Born in 1927
Awarded at age 50

1979
Nobel Prize in Physiology / Medicine

for the development of computer assisted tomography [開發電腦掃描技術]

Godfrey N. Hounsfield
[亨斯菲爾德]
1919-2004
Awarded at age 60

Allan M. Cormack
1924-1998
Awarded at age 55

2003
Nobel Prize in Physiology / Medicine

for their discoveries concerning magnetic resonance imaging (MRI) [開發磁力共振影像]

Paul C. Lautebur
1929-2007
Awarded at age 74

Sir Peter Mansfield
1933 –
Awarded at age 70

Godfrey N. Hounsfield
[亨斯菲爾德]
1919-2004
Awarded at age 60

4. HOW DID HOUNSFIELD INVENT COMPUTER ASSISTED TOMOGRAPHY?

亨斯菲爾德怎樣發明電腦掃描技術?

Godfrey Hounsfield

- Why Hounsfield?
  - Most Nobel laureates were elites but Hounsfield is different
  - His discovery was accidentally
- Born in Nottinghamshire, U.K. in 1919
- Raised in a village farm
- Interested in gadgets and machinery, repairing own electrical recording machines

- 為何只選亨斯菲爾德?
  - 大部分的獲獎者都是有教育背景的專貴, 但亨斯菲爾德就有所不同
  - 他的發現是意外的
- 出生於1919, 諾定咸郡
- 在一鄉村長大
- 對小巧裝置, 機械甚感興趣, 維修自己的錄音機

Godfrey Hounsfield

- Made gliders for fun

- Almost killed himself when playing with water filled tar barrels and acetylene to see how high they could be waterjet propelled

- 自製滑翔機
- 曾玩弄柏油桶及乙炔, 企圖測試噴水的推動力, 幾乎喪命.

Godfrey Hounsfield

- Joined Royal Air Force during World War I as a volunteer reservist
- After war, attended Faraday House Electrical Engineering College in London and graduated with a diploma

- 第一次世界大戰時, 曾參加皇家空軍, 作自願後備軍
- 戰畢後, 入讀倫敦的 **Faraday House Electrical Engineering College** , 獲取文憑.

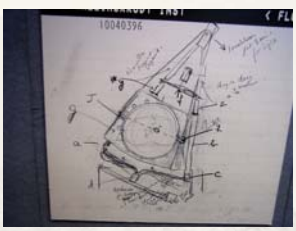
Godfrey Hounsfield

- In 1951, began to work in EMI Ltd in their Central Research Laboratories researching in guided weapon systems and radar
- Became interested in computers, and in 1958, designed the first commercially available all-transistor computer in U.K. (EMIDEC 1100)

- 1951年, 開始在EMI的中央研究實驗室工作, 研究武器導航系統及雷達.
- 及後對電腦感興趣, 1958年在英國, 設計了第一台商品化的全面半導體的電腦.

Invention of CT scanner

- In a walk in the country in a weekend, Hounsfield came up with the idea of using X-ray readings around a box to determine what was inside a box.
- 在一週末郊遊散步時, **Hounsfield**想出一個思想: 沿一個盒的週圍, 用X射線得出的讀數去斷定盒中藏著的東西.



Hounsfield's sketch of experiment
Hounsfield 的實驗草圖

Invention of CT scanner

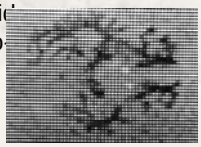
- Initially, both the X-ray tube and the phantom was stationary.
- Next the phantom was made to rotate.

- 在初期的實驗中, X光管及體模都是固定的
- 及後, 使體模旋轉

Prototype CT scanner
雛型的CT掃描器

Invention of CT scanner

- Hounsfield then constructed a computer for input from X-rays at various angles to create an image of the object in "slices".
- The images could display the soft tissues inside a living organism two-dimensionally.
- 繼之, 亨斯菲爾德建構了一台電腦, 用作采集X射線從多個角度進行積分, 而造出一層一層物體的影像.
- 這些影像可以兩維方式顯示生物的軟組織.



First image of a brain specimen
第一張腦樣本的圖像

Image Reconstruction

- By recording on sensors rather than x ray film and taking multiple pictures from a rotating photon source, a series of "slices" could be photographed that showed the different density of tissues.
- 以電腦感應器作記錄替代X光膠片, 及從一個旋轉的光源去攝取多輻圖像, 一系列的薄層可被攝錄, 且顯示組織的密度.

Sir Godfrey Hounsfield
Richmond *BMJ*.2004; 329: 687

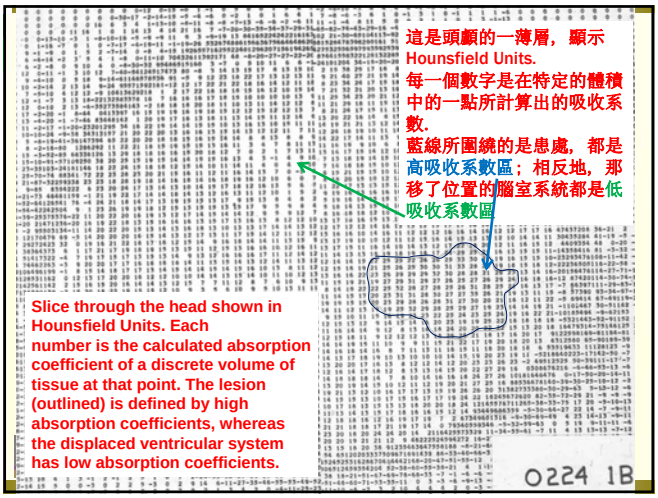
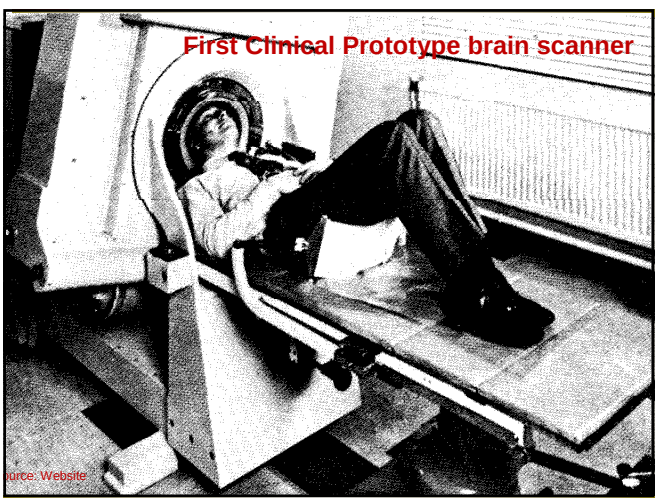
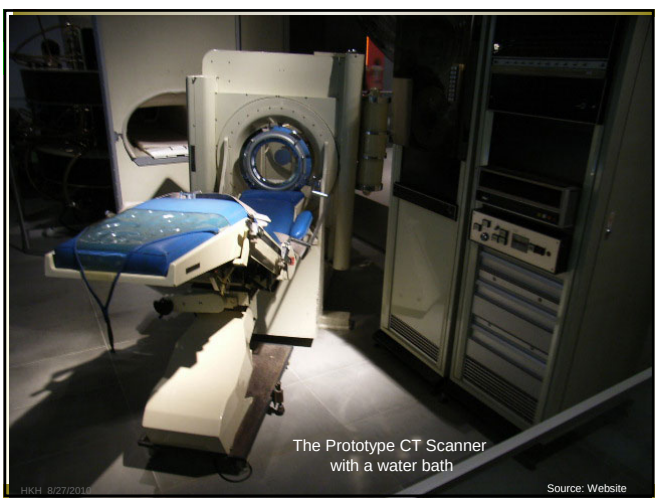


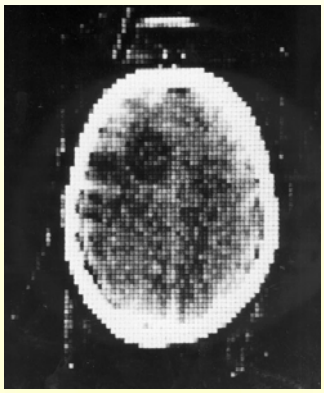
Image Reconstruction

- By making a series of such photographs at close intervals, it was then possible to have a three-dimensional image to display the inside of the body
- Cormack (co-Nobel prize winner) and his team had considered this earlier but dismissed as unworkable.
- 如這些一系列的圖像相距不遠, 就可能構建三維影像, 顯示體內的結構.
- 事實上, Cormack及他的同僚也曾有過同類的思想, 但認為造不來的而擱置.

Sir Godfrey Hounsfield
Richmond *BMJ*.2004; 329: 687

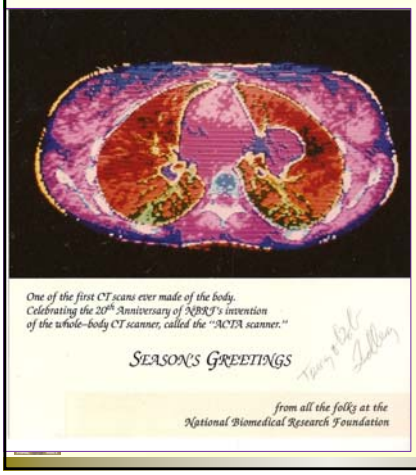






First patient image scanned on the prototype EMI scanner at Atkinson Morley's Hospital on 1st October 1971.

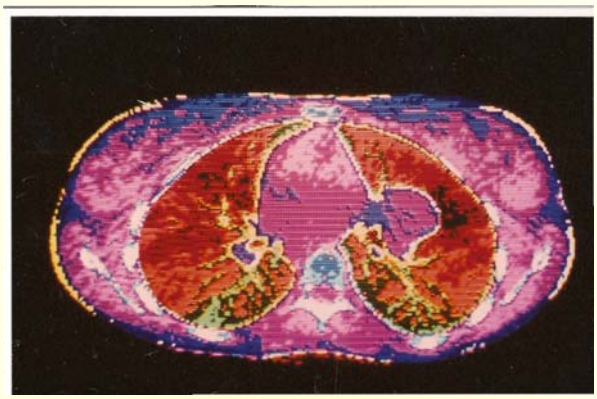
Source: Website



*ACTA whole-body scanner invented by Ledley, Huang et al. in Georgetown University 1973 with new method for image reconstruction, the tilting gantry and the ability to handle large differences in the absorption coefficients of contiguous areas.

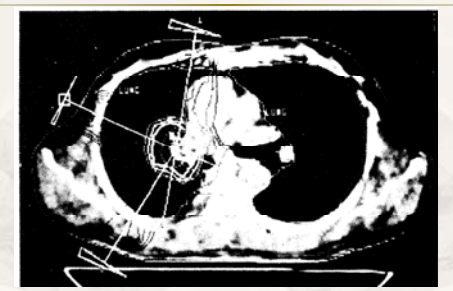
雷德利，黃煥慶等於1973年在喬治城大學發明了全身用的ACTA掃描器，包括嶄新的影像重建方法，可傾斜的機體及能處理在相鄰區域吸收系數的大差異.

*ACTA: Automatic Computerized Transverse Axial scanner



One of the first few whole body CT images from the ACTA, 1974, Georgetown University

Application of CT



Computer calculated isodose distribution for radiotherapy, 1979

1979年用於放射治療的電腦計算等劑量分布圖

Source: Website

5. IMPACT OF HOUNSFIELD'S INVENTION

亨斯菲爾德的發明帶來的影響

5. Impact of Hounsfield's invention

- "The computed tomography scanner represents one of the most important contributions to neurosurgical practice in the past 100 years, and its development is a remarkable story of scientific endeavor." (Neurosurgery, 28, 2006, 780-87)
- **"電腦斷層掃描器是在過去100年中,對腦外科專業其中一個最大貢獻．它的建成是科學研究中顯赫的一個故事."**
- (Neurosurgery, 28, 2006, 780-87)

Impact

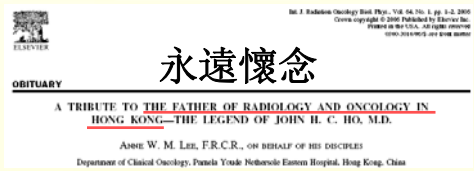
Clinically

- Change in radiographic techniques e.g. 5 views for Nasopharynx (Ho's NP views) are not needed any more

臨床方面

- 改變了我們以往的影像方法，例如：從前照鼻咽部位是要用5個位置（Ho's NP views,)現在已擱置.

永遠懷念


OBITUARY

A TRIBUTE TO THE FATHER OF RADIOLOGY AND ONCOLOGY IN HONG KONG—THE LEGEND OF JOHN H. C. HO, M.D.

ANNIE W. M. LEE, F.R.C.R., ON BEHALF OF HIS DISCIPLES

Department of Clinical Oncology, Pamela Youde Nethersole Eastern Hospital, Hong Kong, China

香港放射學及腫瘤學之父-- 鼻咽癌鼻祖.

Prof. John H.C. Ho (何鴻超教授) 1916-2005

Acknowledgement: Int. J. Radiation Oncology Biol. Phys., Vol. 64, No. 1, pp. 1–2, 2006

Impact

Clinically

- Staging of tumours
- Patient management
- Accuracy of radiotherapy planning & treatment
- CT-guided biopsies

臨床方面

- 腫瘤的分期
- 病者的處理
- 放療的設計及治療的準確度
- CT導航的活細胞組織檢查

Impact

Technologically

- CT has revolutionized medical imaging from 2-D to 3-D and to 4-D now.
- By 1976, the reconstruction techniques used in CT were already being applied to other areas including US and NMR, starting the 3-D era in imaging.

技術方面

- CT改革了醫學影像，從二維到三維及至現今的四維
- 及至1976年，CT的影像重建技術已應用在其他領域包括B-超，NMR，開展影像三維的時代.

6. INSPIRATION FOR OUR GENERATION

對這一代的啟發

Inspiration for our generation

Personally

- The discovery was not within Hounsfield's profession and quite accidental
- Hounsfield did not undergo university training like other Nobel laureates.
- His idea was not well received initially
- He did not learn anatomy or physiology
- He knew little about medicine.

個人方面

- 亨斯菲爾德的發明並不在其專業中，且屬意外.
- 亨斯菲爾德並不如其他諾貝爾獲獎者，他並沒有接受大學教育
- 他的主張早期亦未獲到認同
- 他沒有學過解剖學或生理學
- 他也沒有醫學知識

But he received the Nobel Prize in Physiology or Medicine

但他榮獲諾貝爾生理學醫學獎

Inspiration for our generation

Factors leading to success:

1. Hounsfield showed interest in different things around him.
2. He thought outside of his own "box".
3. He immediately put his ideas into action (unlike Cormack)
4. He had passion for his interest.

成功因素:

1. Hounsfield 對週遭事物都感興趣
2. 他跳出自己的框架去思考
3. 與Cormack不同，他立即將思想付諸行動
4. 他全情投入自己的興趣

Inspiration for our generation

Factors leading to success:

5. He was persistent
6. He had a promoter, Dr. J. Ambrose, a neuroradiologist. (Oldendorf, an American neuroradiologist, had similar idea patented in 1963, but was dismissed by manufacturers as impractical

成功因素:

5. 他有恒心
6. 他有宣傳者，**Dr. J. Ambrose**, 一位神經科放射醫生. (**Oldendorf**, 一美國神經科放射醫生在1963年已獲取這概念的專利權, 但被廠商認為不實際而摒除.)

Inspiration for our generation

The present world

* Fast advancing technology
* Complex imaging modalities using various energy sources augmented with computer technology
* Imaging at molecular level
* Non-radiation source imaging e.g. MRI, US,

現今世界

* 科技特飛猛進
* 圖像採集設備變得複雜, 有採用不同的能量源, 也有利用電腦技術強化之
* 圖像採集已進入分子層面
* 也採用非輻射源，如MRI，B-超，及温度等

Reflections 反思

* Can we remain status quo?
* Are we happy to be called a "button-pusher"?
* Either we grow or we "perish"
* What are the changing roles of radiological technologists?

* 我們可以維持不變嗎?
* 我們樂於被稱為"按鈕員"嗎?
* 我們不增長就會被毀滅（圖汰).
* 我們的角色應如何改變?

7. OUR WAY FORWARD
我們的前路

Our way forward

Evidence-based practice

* Evidences are results from research and clinical studies
* Research should underpin clinical practice to obtain first-hand information rather than "hearsays"
* Hounsfield's invention is our role model. We all have his ingredients to success. It all depends on how we use them

以實據爲基的專業實踐

* 實據是研究及臨床測試所得的結果.
  我們要第一手資料而非"道聽途說"，所以不斷要在以研究來強化臨床工作.
* 亨斯菲爾德是我們專業的典範. 事實上，我們都可能擁有他賴以成功的素材，問題是怎樣運用.

Our way forward

Cross disciplinary approach

- We often hear about role expansion in the contemporary world. Roles in each discipline are less clearly defined in the changing world.
- Contemporary curriculum tends to be broader based for the new generation.

跨專業的取向

- 在這世代，我們常聽到角色擴展．事實上，在這變化中的世代，每個專業的角色也較前模糊.
- 現代就是專業的課程，也傾向擴濶多一些.

Our way forward

Cross disciplinary approach

- Additional knowledge in various subjects (e.g biology, physics, chemistry, information technology, etc.) is needed to handle the emerging modalities
- But to train the new generation in critical thinking outside of one's box is the most important of all. (This is a challenge to the older generation.)

跨專業的取向

- 為能應付新興的影像設備，各學科(如生物，物理，化學，資訊科技等)的知識都要加強.
- 但最重要的，還是訓練新的一代能像亨斯菲爾德般能跨越自己專業的框架去作批判性的思考.(這是對老一輩的挑戰.)

8. CONCLUSION

Conclusion

- Hounsfield and his team created the CT scanner with little money and few resources.
- Lord Rutherford said, "We had no money, so we had to think."*

- 亨斯菲爾德的團隊以很少的資源創造了CT 科技
- Rutherford 說：“我們沒有錢，所以我們要思考.”

*Wells, Medical Engineering and Physics, 23(3), 2001: 153

Conclusion

- Who can tell what new applications in medicine are waiting to emerge?
- The past must not be perpetuated but it must be used as the springboard into a future that will certainly be astonishing

- 誰能說有什麼新的醫療設備在等候著面世?
- 過去的事不可以是永恒的．我們要把過去的當作邁向未來的跳板．我們的未來肯定是令人驚訝的!

Conclusion

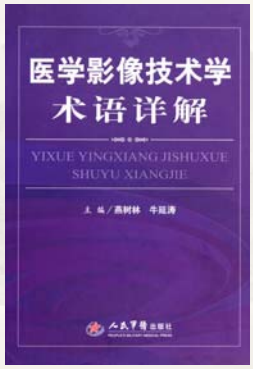
- Winning the Nobel Prize looks distant for us.
- If we can nurture a questioning and thinking culture in our profession, we may still stand a chance.

- 獲取諾貝爾獎似是遙不可及.
- 如果我們努力在專業中栽培詢問及思考的文化，我們仍有機會.

Hounsfield's comments for all would-be Nobel prize winners

- "Don't worry too much if you don't pass exams, so long as you feel you have understood the subject.
- It's amazing what you can get by with the ability to reason things out by conventional methods, getting down to the basics of what is happening."
- "如果你考試不及格，不要過於顧慮，只要你明白那學科就可以了.
- 能夠有能力用傳統方法去推理，走到事情的基本，你會驚訝你所得到的."

Acknowledgement



Thank you for your attention.

謝謝