Who do we credit for launching CT in 1971?

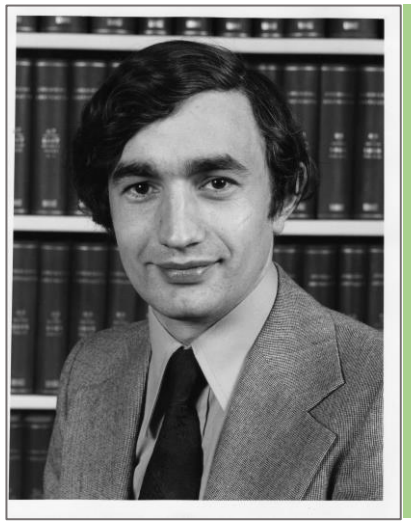


Image reconstruction:

Stephen Bates

Godfrey Hounsfield

Godfrey Hounsfield

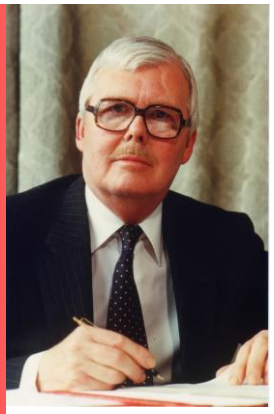
Risk-takers:

Godfrey Hounsfield

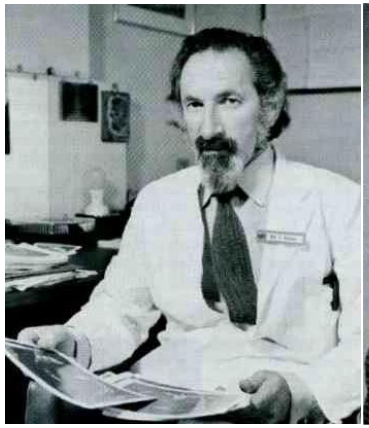
Bill Ingham

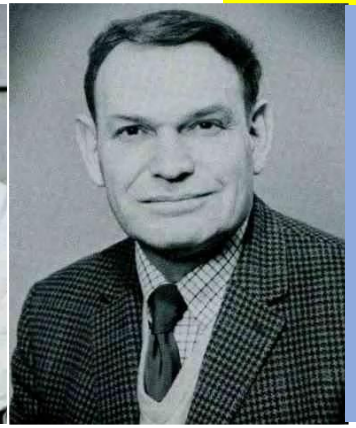
Cliff Gregory

Frank Doyle



Here are the top seven





Radiologists:

Louis Kreel

James Ambrose

Frank Doyle

Hounsfield's relentless determination

Hounsfield forced CT through to a clinical trial which overturned 75 years of received wisdom in radiology and industry

Top radiologists at UK teaching hospitals rejected Hounsfield's 1969-70 CT scans of excised tissue as an expensive step backwards in spatial resolution

Industry held the same view: *"In Munich around 1967, a group of Siemens scientists studied the feasibility of CT, and assumed that any new radiographic technique must produce images with spatial resolution at least as good as existing x-rays. They estimated that the world's fastest computer could not complete the necessary calculations in a reasonable time. So the idea was premature and perhaps should be re-examined in 10–20 years."*

Quotation abbreviated from Walt Robb, see full version in Acad Radiol 2003; 10:756–760

Hounsfield's contributions to CT

It was as much a one-man invention as anything can be these days

Source: MacRobert Award brochure, EMI, 1972

- Vision: CT will give perfect density values to outweigh lost resolution
- Hounsfield's reconstruction algorithm ran fast on early computers
- Proof of vision & algorithm by simulation with Stephen Bates
- Getting it funded by the UK Department of Health – the American story of easy funding from profits from The Beatles is totally incorrect
- Persuading excellent medics to collaborate with him
- Improvising an excised-tissue scanner and building the clinical prototype on an astonishingly low budget, because he had no other option
- Taking a big risk with his employer's money: if it failed his job might be lost

Stephen Bates

CT image reconstruction algorithm

- Godfrey Hounsfield tested his algorithm by manual calculation and then asked Stephen Bates to show him how to operate the computer terminal which was shared by all researchers
- Stephen was intrigued and teamed up with Godfrey to adapt the manual method to run on that computer, and in the first clinical CT scanner
- The importance of Stephen's contribution was immense: he was the only non-family person who Godfrey invited to the Nobel prize ceremony
- Together they developed the algorithm and optimised parameters:
  - For speed on computers which were slow except for add & subtract
  - For low noise by matching the reconstruction to the beam width

James Ambrose

Excellent neuro-radiology collaborator

- James (Jamie) Ambrose was an excellent choice as collaborator because he understood the drawbacks of existing methods of assessing brain disease and had spent the last ten years trying to overcome them
- He supplied a formalin-fixed brain sample in 1969 and ‘read’ the CT scan
- From May 1970 onwards he and his team helped Hounsfield to develop a clinical CT scanner which was compatible with hospital standards and work-flow, and was comfortable for the patients
- From October 1971 he scanned patients, read the CT images, published the results and showed the clinical scanner to visitors from the USA and all corners of the world

Louis Kreel

Important collaborator in 1969 and especially after 1974

- Louis Kreel was an important collaborator in the excised-tissue tests in 1969-70 because his samples of piglet abdomens showed that CT could visualise the pancreas and kidneys
- Together with Frank Doyle and Jamie Ambrose, Louis Kreel enthusiastically recommended to DoH in January 1970 that building a clinical CT scanner was the next step
- When Hounsfield's full-body CT scanner prototype was ready in December 1974 it was installed at Northwick Park Hospital to be used by Louis Kreel and his team

Frank Doyle

Approved project in 1968, collaborated in 1969 bone density tests

- Crucially, Frank Doyle was chosen in August 1968 as an independent ‘peer’ reviewer by Evan Lennon, a radiologist in Cliff Gregory’s team
- An excellent choice because Doyle was already trying to measure density accurately, so he did not immediately reject CT as most radiologists did
- Frank Doyle was a radiologist who was interested in measuring the bone content of lumbar vertebrae and he proved that application of CT in 1969
- Doyle studied science at St Andrews before becoming a radiologist, so he understood the physics as well as the un-met medical needs
- The review included face-to-face discussions of greater depth and usefulness than today’s standardised method of peer review

Cliff Gregory

Took the risk of backing CT with public money

- Cliff Gregory ran the Scientific and Technical Services Branch of the UK Department of Health
- Godfrey Hounsfield described his ideas for CT to Cliff Gregory in July 1968, showing image reconstruction simulation by Stephen Bates
- It would have been easy for Cliff to reject CT, because he was subjected to a regular stream of hopeful inventors and hardly any were worth backing
- Cliff knew that CT meant lower spatial resolution and that computers were expensive, but he saw the revolutionary potential of perfect density values
- So he backed a highly speculative idea, but kept a tight rein on funds and asked for the independent review by Frank Doyle

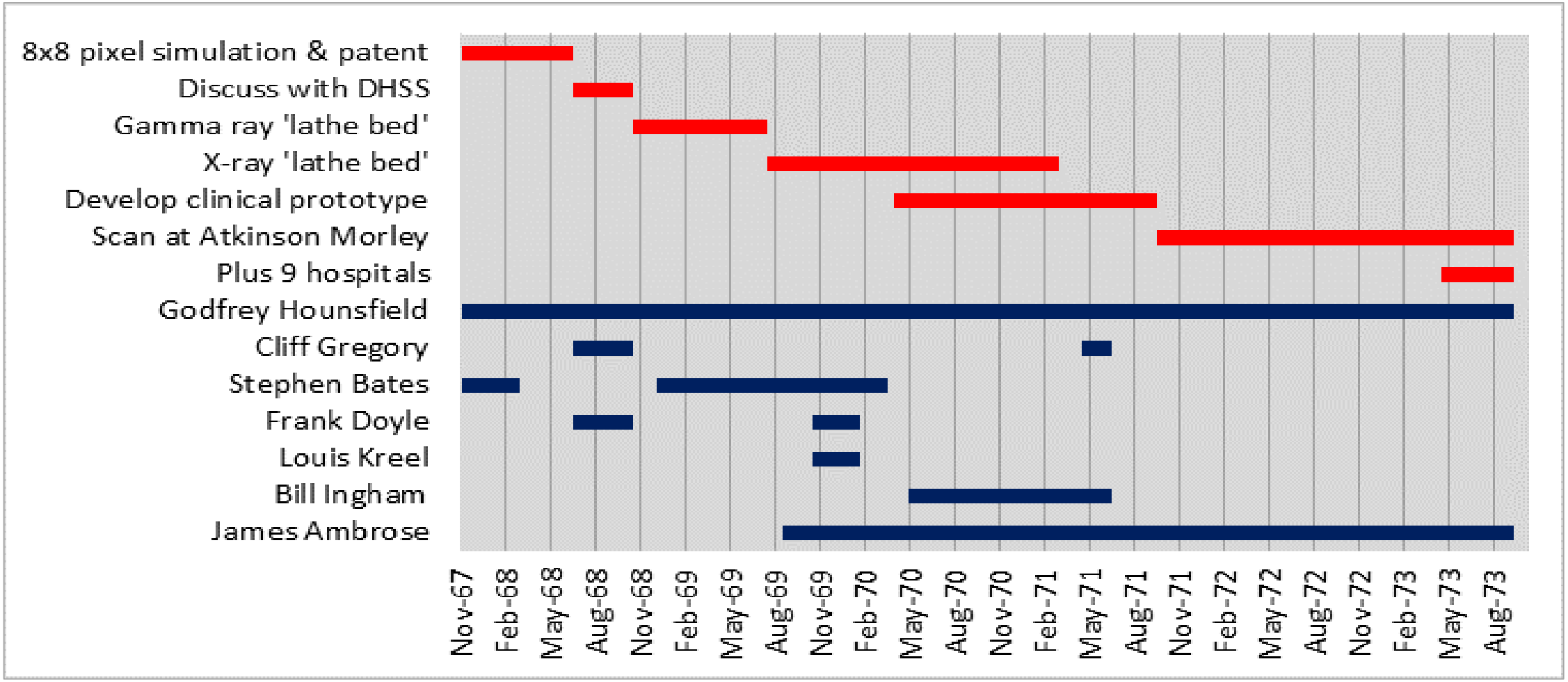
Bill Ingham

Took the risk of the CT project failing to collect DoH funds

- Bill Ingham became director of EMI Central Research Labs in 1970 and so became responsible for research including Hounsfield's CT project
- The CT project was ready to start designing the clinical scanner
- But most radiologists saw no future in CT and EMI would not proceed unless everything was funded externally, ideally by Dept. of Health
- Bill Ingham risked 14 month's work before DoH signed the contract
- Bill Ingham took the risk of the clinical scanner failing DoH acceptance test
- If it failed that test then it would cost EMI a lot of money and contravene an explicit instruction from Bill's boss not to spend EMI's money on CT – so Bill's reputation and perhaps his job were on the line

CT time line to September 1973

Activity:	Pre-contract	Lab tests using ‘lathe bed’	Develop clinical prototype	Clinical trial, publication	Roll out



Hounsfield drove it continuously: others helped as needed

Wouldn't CT have happened anyway?

Yes, but received wisdom was a huge hurdle

- Improving spatial resolution was top priority for radiologists and industry
- Top radiologists at UK teaching hospitals rejected Hounsfield's 1969-70 CT scans of excised tissue as an expensive step backwards in spatial resolution
- In 1967 to 1970 Siemens invested 15 person-years in CT concluding that spatial resolution must match x-ray film which needed computer power which was 10 – 20 years away, so they decided to abandon the study
- Godfrey Hounsfield based the clinical CT scanner on his vision that precise density measurement far outweighs even a 30-fold loss of resolution
- It only took 5 person-years to deliver the breakthrough!
- For Hounsfield it was not a study and abandoning it was never an option

CT would have arrived later and in a less revolutionary manner without these 7 people

- Later (by 10 years?) because nobody else was ready to face the hurdles of received wisdom and the cost & risk of speculative development
- Less revolutionary because an alternative to Hounsfield's CT scanner would be more highly specified and expensive and thus slower to roll-out
- Hounsfield & Ambrose accurately judged the minimum-cost design needed to show a compelling breakthrough and trigger a revolution

- We have named 7 people, but others at the hospital, at the Department of Health, and at EMI made important contributions