



Recent Advances in Radiology

Good Picture - 2023 “Diversity of Imaging” An RPS Symposium

Dr Adrian Thomas

Visiting Professor

Canterbury Christ Church University

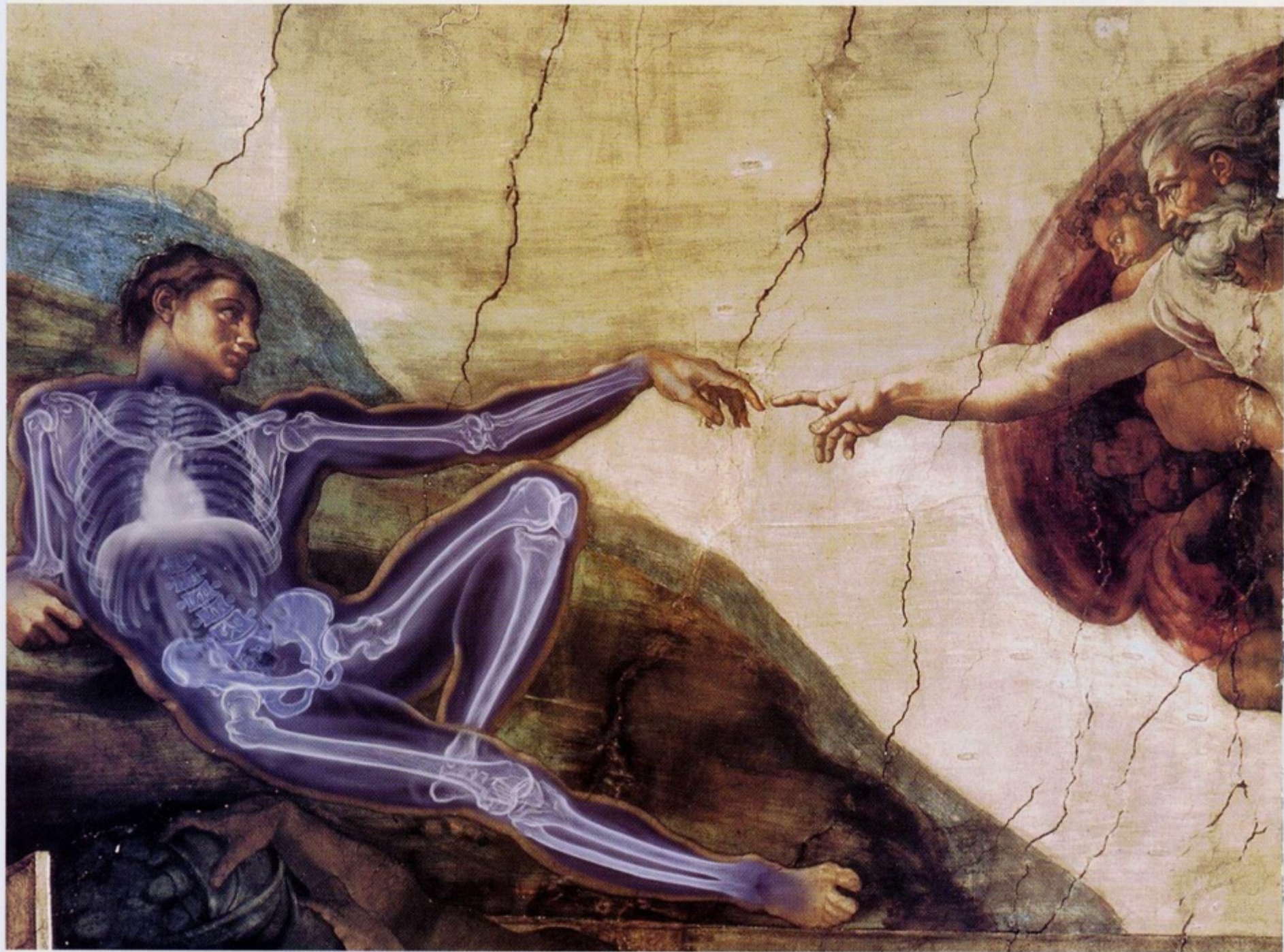
Honorary Historian

The British Institute of Radiology



**Canterbury
Christ Church
University**





Rt Hon The Earl of Crawford, KT James Lindsay, 26th Earl of Crawford

- James Ludovic Lindsay (1847-1913) KT, FRS, FRAS.
- Elected president of the Royal Astronomical Society in 1878.
- 1897: One of first three honorary members of the Röntgen Society.
- President of Royal Photographic Society, 1896-1900.



"Astronomy"

Lord Lindsay

L'Abbé Henri de Tourville (1842-1903).

- The world is changing, with **breath-taking rapidity**.
- **A period of twenty years today brings more changes than a hundred did previously.**
- Railways, telegraphs, telephones, automobiles, the rapidity and multiplicity of the means of communication, machine tools and the application of science to everything as well as the **uprooting of everything and everybody**, compel us to **new ways of feeling, thinking and living**.
- The dawning of the natural sciences has brought about **this new situation**, and they will never have said the final word, indeed they are only in their infancy.
- We have **broken finally with the past** where everything tended to remain static.
- From now on the world is launched on a **course of material transformation which nothing can halt**.

RHINOCERON



1515

J. H. L.

10

One thing leads to another:

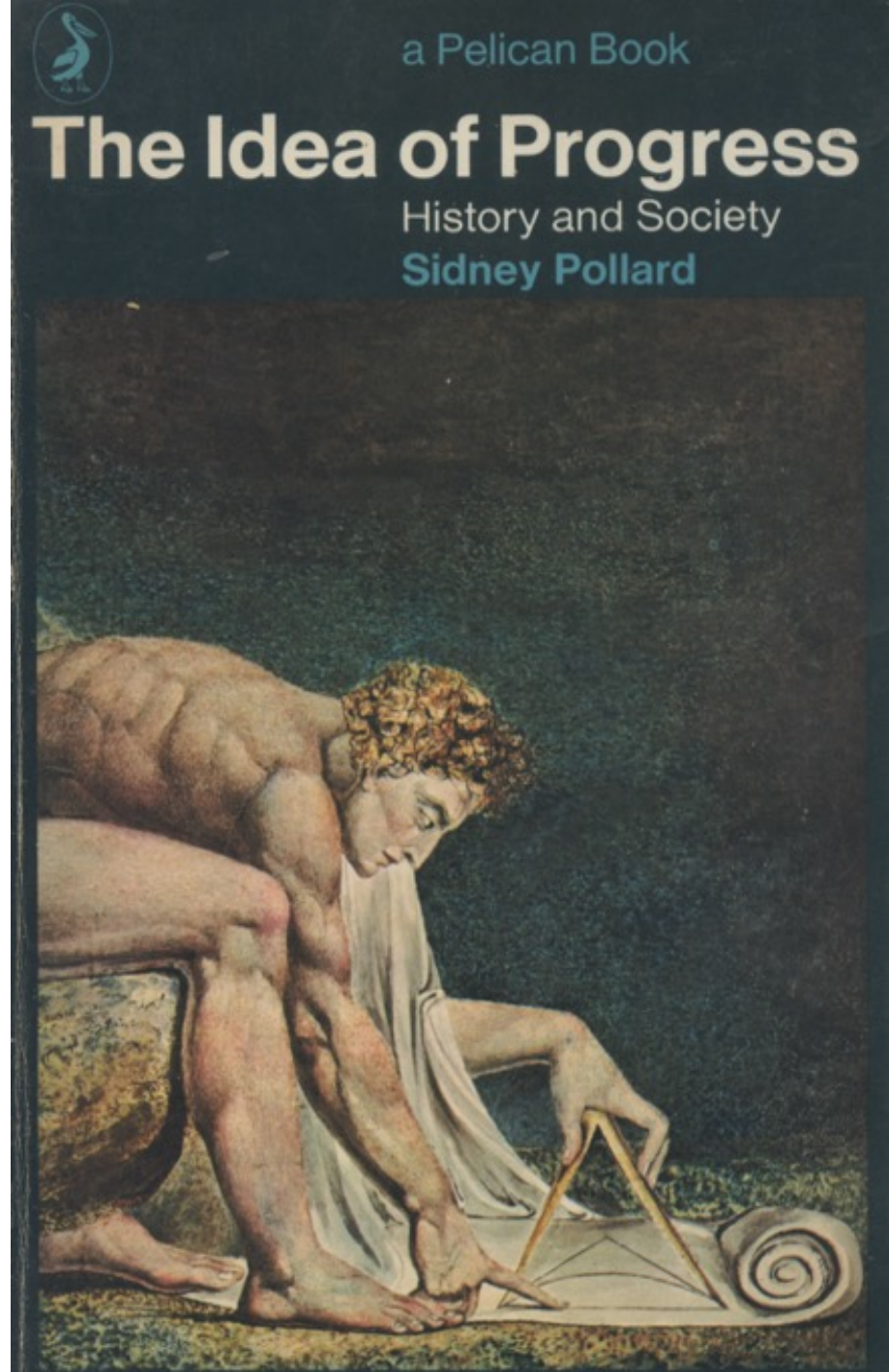
- One development facilitates another.
- Key developments:
 1. Focus tube.
 2. Coolidge tube.
 3. Bucky grid.
 4. Shockproof apparatus.
 5. X-ray television.
 6. Automatic Processing.
 7. Digital imaging: CT, PACS, AI &c.

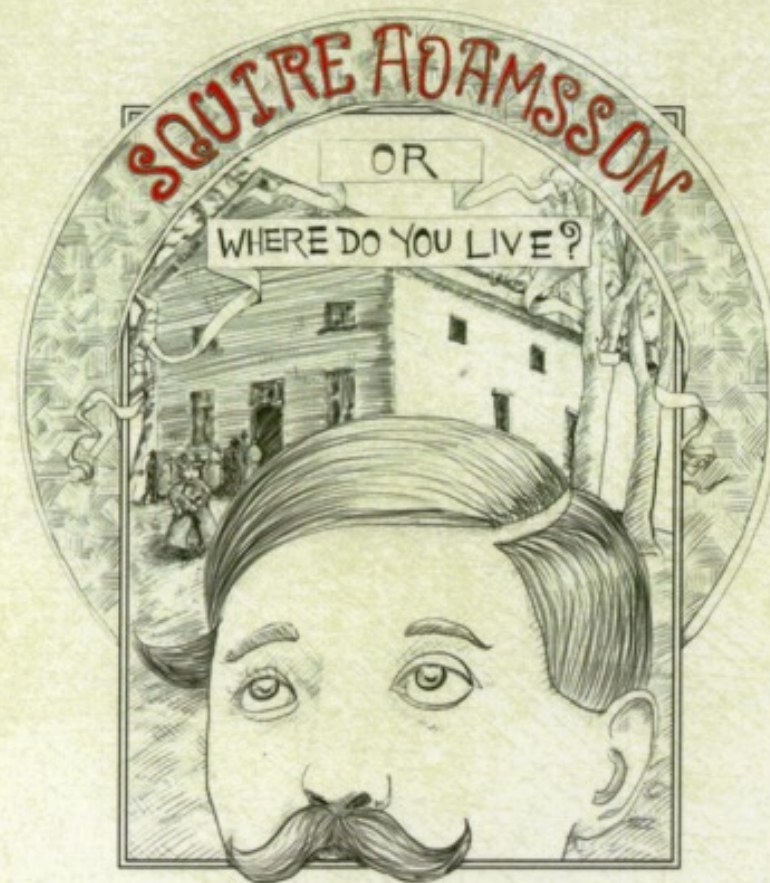
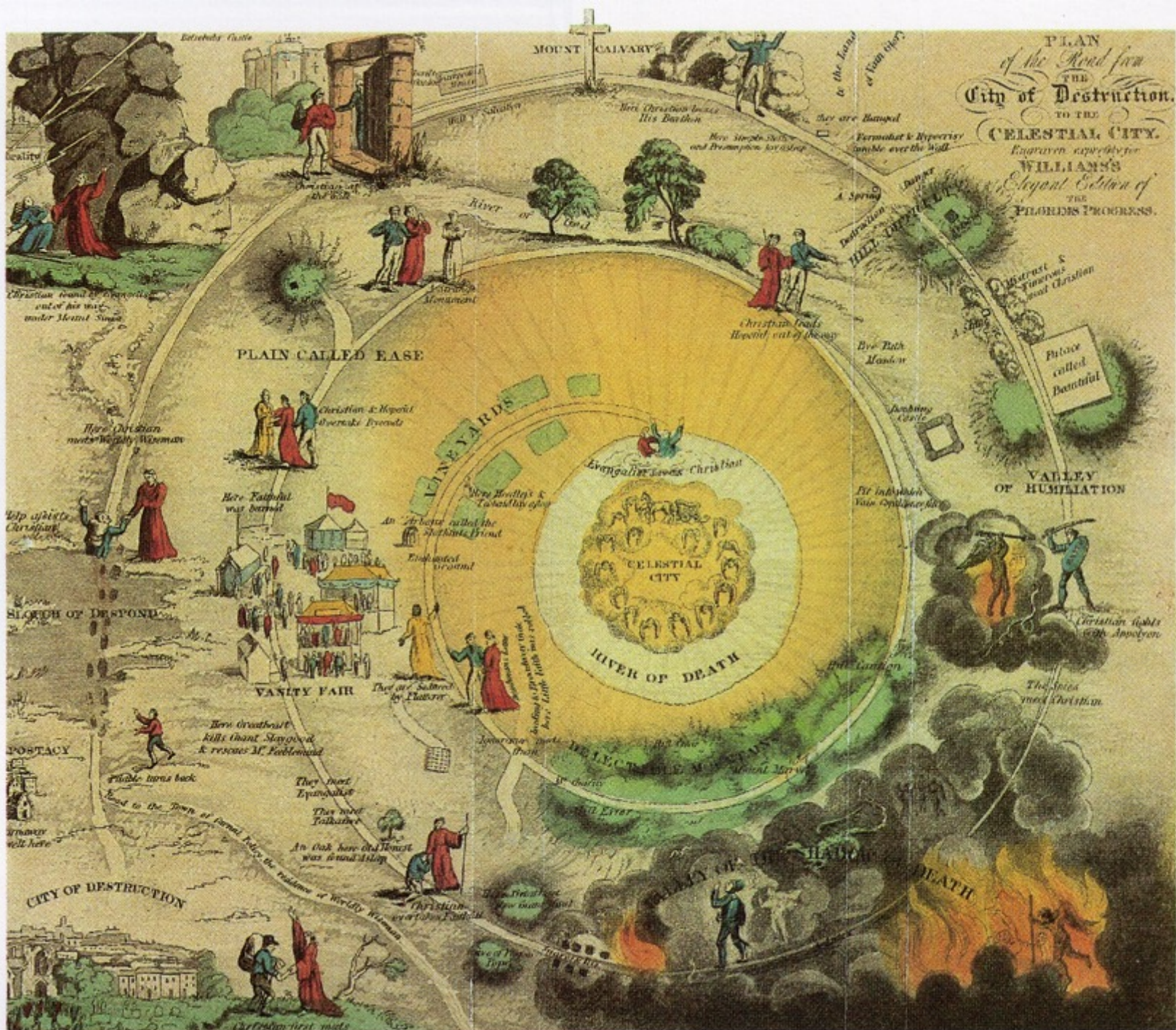


Progress.

- “Whether progress is an illusion or a reality, this recent concept of mankind’s is certainly the most universal religion of the modern world”

(1968)





An Allegorical Tale from the Swedish Awakening

by Paul Peter Waldenström

Translation with Introduction and Notes

by Mark Safstrom

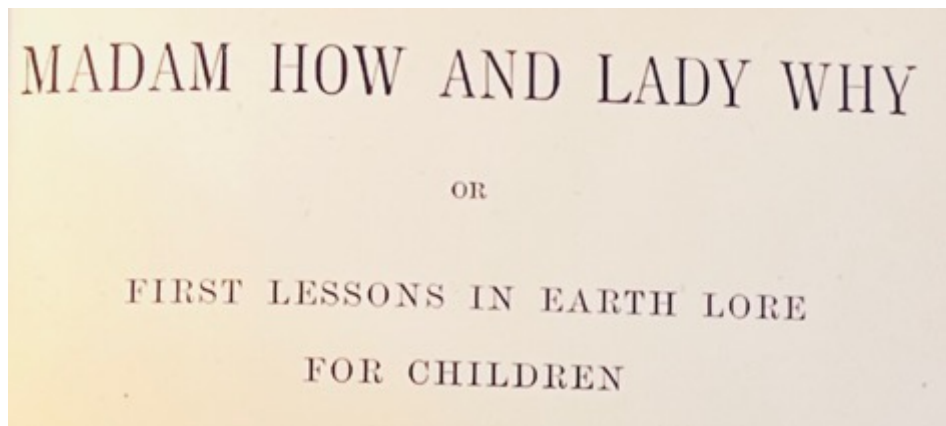
Various Elements of Radiology:

- **Photographic**: Recording media (plate, paper, film, digital/virtual/PACS).
- **Electrical Engineering**: X-ray tubes & generators.
- **Mechanical Engineering**: X-ray tables.
- **Anatomical**: Normal and developmental.
- **Medical**: Transformation of diagnosis and investigation.
- **Chemical**: Contrast media, plastics, metallurgy.
- **Civil Engineering**: Hospital and departmental design.
- **Cultural**: Art, novels, & films.

Madam How and Lady Why (1869)

Charles Kingsley.

- If your heart be pure and sober, gentle and truthful, then Lady Why speaks to you without words, and tells you things which Madam How and all her pupils, the men of science, can never tell.




5W + 1H.

- **Who** is it about?
- **What** happened?
- **When** did it take place?
- **Where** did it take place?
- **Why** did it happen?
- **How** did it happen?



Who is it about?

- Who is the referrer?
- Who is the patient?
- Whom is the duty to? Patient, state, referring clinician.
- Who receives the report?
- Who owns the data?
- Who does the reporting?



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Who is the Patient?

Sir Gordon Wolstenholme (1913-2004).

- "Healthcare - a world health service - is an essential step toward man's wellbeing and toward a world society. If we cannot work together for the health of mankind we are rightly doomed" (1967).
- Diversity, equity, and inclusion refers to organizational frameworks which seek to promote "the fair treatment and full participation of all people",

Who reports?

June 1970, A three-day London conference:
'The Future of Diagnostic Radiology'.

- Participants: 12 British and 14 American radiologists.
- It concluded that in order to achieve excellence in patient care as well as in academic pursuits, that higher radiology staffing levels were necessary than were then available in most British and many American hospitals.
- It is remarkable that the meeting said that consideration should be given to having **technicians and 'super-technicians' handle some of the simpler tasks presently performed by radiologists.**
- Margulis, A.R., Steiner, R.E. 1970. *Editorial: British-American symposium A conference on the future of diagnostic radiology.* British Journal of Radiology, 43, 833-834.

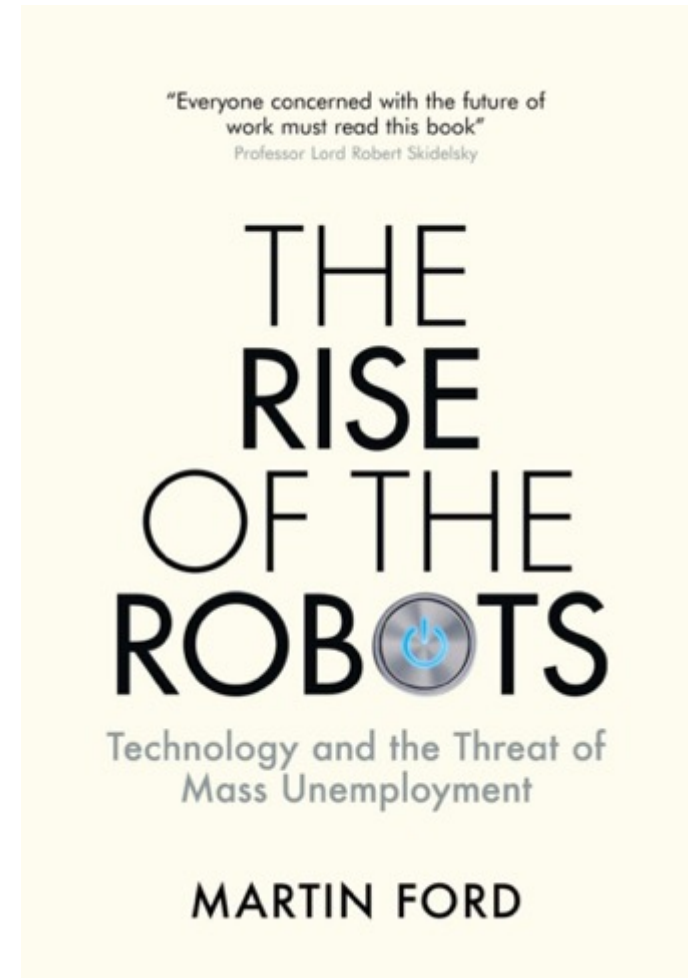
Traditional Department.

- Administration and Clerical Staff.
- Consultant Secretaries.
- Filing: Report Cards and film packet.
- X-ray Porters.
- Darkroom technicians.
- Doctors.
- Radiographers.
- Nurses.
- I was always with someone!



The Rise of the Robots, Martin Ford (2015).

- The staff that remain in the 2020s seem significantly more unhappy than those in the 1970s and 1980s.
- Ford discusses the history of mechanisation in the West. Displaced farm labourers entered the manufacturing sector, and more recently into new service jobs.
- With the rise of technology Ford shows how new jobs were created and the dispossessed workers were able to find new opportunities. These new jobs needed upgraded skills and paid better wages.
- Ford stated that at no time was this more true than in the twenty-five years after the Second World War, and this was a golden age for the West with a seemingly perfect symbiosis between rapid technological progress and the welfare of the workforce.
- The machines improved, production increased, and salaries and wages rose.



The Rise of the Robots, Martin Ford (2015).

- The 1970s and 1980s were a golden decade for radiology - rapid technological advances and transformation of medical care.
- There is now a shift in the relationship between workers and machines.
- The machines are no longer tools to increase the productivity of workers, the machines themselves become the workers.
- The changes that took place in X-ray technology made the equipment easier to use and productivity increased.
- The examinations were traditionally controlled by a radiographer and radiologist. In the future the radiograph will be obtained using an AI protocol, the patient guided by an assistant with simple training, and the radiograph will be reported using another AI protocol.

What happened?

- There are now a multitude of investigations and treatments that can be performed.
- Examples: Plain films, fluoroscopy, contrast studies, ultrasound, CT, nuclear medicine, MRI &c.
- There are also imaging assisted and imaging guided interventions.
- Deciding which is appropriate requires significant wisdom and experience.
- Traditionally choices were very limited and choices were simpler.

When did it take place?

- Sir Gordon Wolstenholme: Healthcare can be:
 - Universal.
 - High quality.
 - Immediate.
 - Low cost.
- However it cannot be all of these at the same time.
- There is little point in having a perfect report if the incident is passed. However unsuspected findings may be found.

Where did it take place?

- Essentially imaging (and investigations generally) should take place close to the patient, with as little movement of the sick patient as necessary.
- Concept of near-patient testing.
- FAST ultrasound &c.
- Reporting may be very distant from the point of patient contact.

The EMI (or CT) Scanner

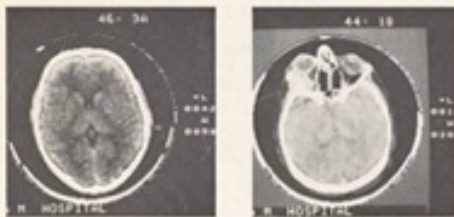
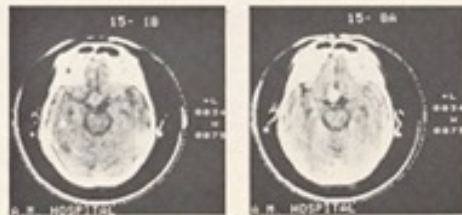
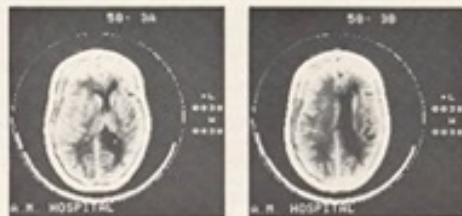
Marks the paradigm shift!

“Until his discovery X-ray photography has not advanced fundamentally since RÖNTGEN X-rayed his wife’s hand in his laboratory in Würzburg in 1895.”

James W D Bull 1977

EMI-Scanner CT1010

The most advanced diagnostic system for *Soddy House* neuroradiological examinations



EMI

EMI Medical



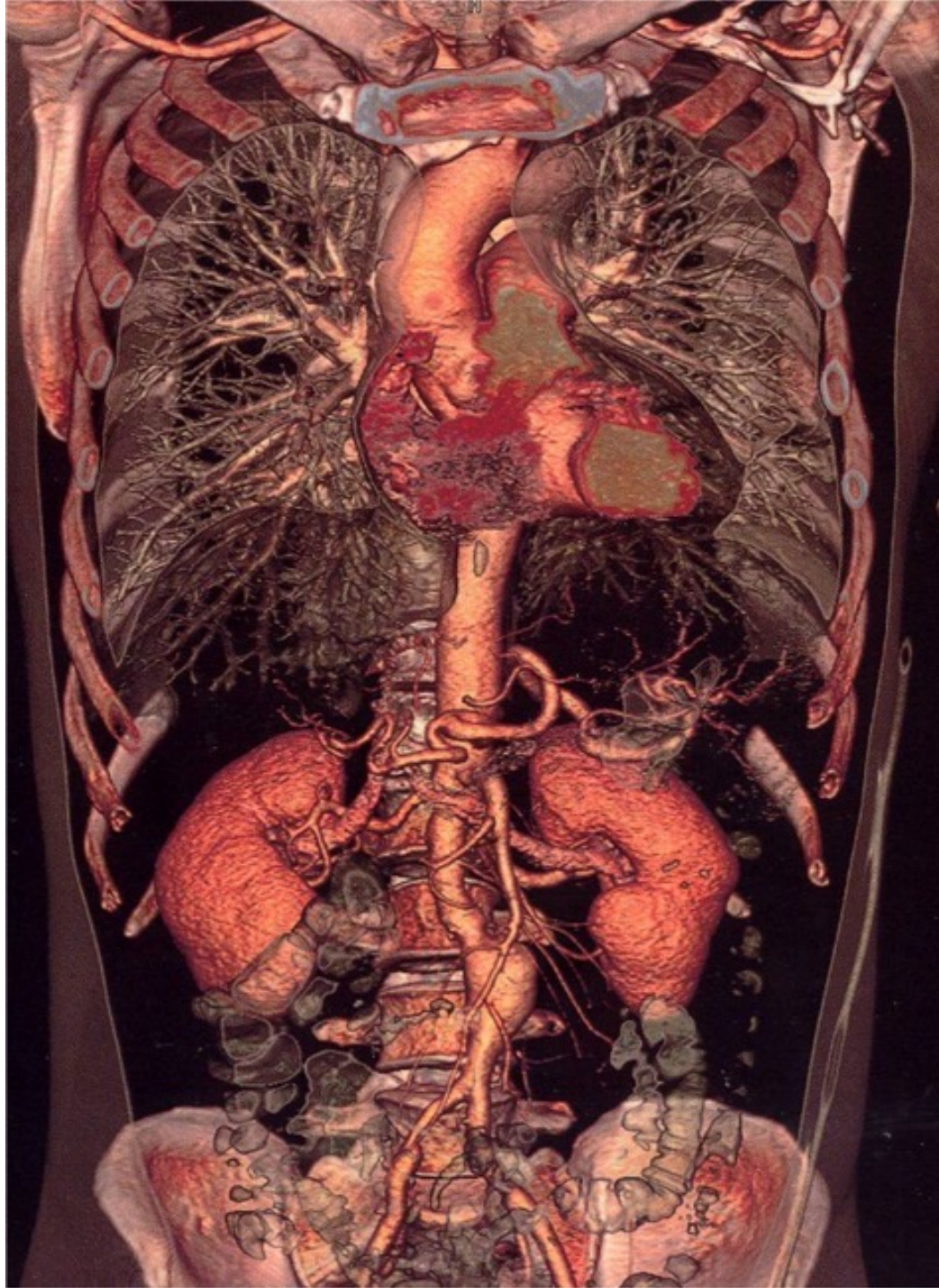
Embarass de richesse.

- The benefits of the scanner were so overwhelming as to be obvious.
BMJ Editorial (1975) 2, 295-6.
- “No need for a randomised controlled trial to make sure that we could believe what we were seeing.”
Brian Jennett 1984.
- However:
- In one centre there was no change in morbidity and mortality, fewer invasive tests, total costs for diagnosis increased.
H Fienberg, AJR (1978) 131, 1-4.

Head Injury.

- AMH 1976: Head Injuries: Replaced angiography and reduced burr holes. Mortality not reduced (Ambrose).
- Glasgow: CT often revealed clinically unsuspected haematoma. Still using long established criteria for transfer – clinical deterioration needs to have taken place. Changed referral guidelines in 1978.
- Conclusions in 1978: Some neurosurgeons advising that scanners should be placed in district hospitals: to avoid transfer to regional units (Bartlett, Neil-Dwyer & Benham 1978).

CTA: entire
aorta.



Why did it happen?

- This is the most difficult of all of the questions.
- That we can do something does not mean that we should do it.
- Can we have too much medicine?
- Does more medicine make us more healthy?
- Idea of Ulysses Syndrome.

BMJ

344:1-52 No 7859 Clinical research ISSN 0959-8138
2 June 2012 | bmj.com

Maintenance drugs for opioid dependence
How to deliver a consultant led service
BMJ Group Awards: the winners
Managing ventilator assisted pneumonia

JOBS, COURSES, AND CAREERS



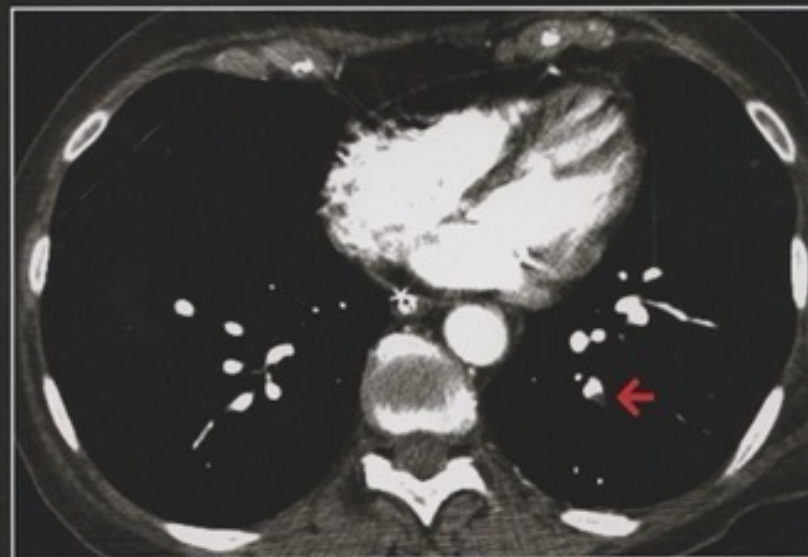
OVERDIAGNOSIS
Harming the healthy

BMJ

347:1-38 No 7915 Clinical research ISSN 0959-8138
6 July 2013 | bmj.com

Helping patients to die at home
Chronic hepatitis B: NICE guidance
Post-traumatic stress after intensive care
Meet the new masters of public health

JOBS, COURSES, AND CAREERS



Overdiagnosing pulmonary embolism
NEW SERIES ON UNNECESSARY CARE

Streather, J.
2019.

Is Medicine Still Good for Us? A Primer for the 21st Century.



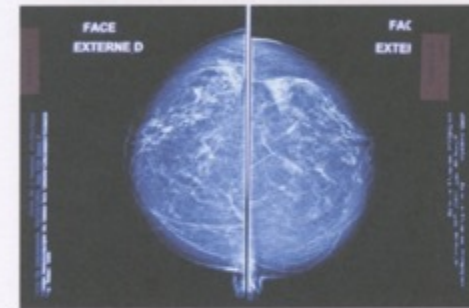
Increased medical activity with no health gain is the definition of too much medicine.

A classic case of over-diagnosis and over-treatment is thyroid cancer. In a deft research article from 2013, US health care researcher Juan Brito and colleagues showed how the use of increasingly sophisticated diagnostic techniques led to a threefold increase in the detection of papillary thyroid cancer in the past 30 years, with absolutely no corresponding change in mortality.

DNA sequencing The identification of the precise order of the four chemical building blocks in a DNA molecule. Provides information about the genetic information carried in a particular strand or segment of DNA.

A Entrepreneur Jared Rosenthal set up a mobile DNA testing van in 2010. The explosion in direct-to-consumer diagnostics means we can find out more about our underlying health state. How much of this information can be translated into meaningful clinical findings is less certain.

B It is possible that the information disclosed by these home DNA testing kits would need careful medical interpretation and explanation. More information is not always better. Testing can lead to over-diagnosis and costly, unnecessary treatment.



Randomized controlled trial (RCT) A study in which a number of people are randomly assigned to two or more groups to test an intervention. One group has the intervention; the other, known as the comparison or control group, has an alternative intervention, a placebo or no intervention at all. RCTs are said to be the 'gold standard' for clinical trials of drugs or other medical intervention.

Embolism An obstruction in an artery, usually caused by a blood clot or a bubble. If an embolism obstructs the flow of blood to a major organ it can result in serious morbidity or death.

Commercial players such as drug companies and manufacturers of medical devices have a strong interest in expanding disease categories. In 2014, Australian health journalist Ray Moynihan and colleagues studied 16 publications from national and international guideline panels defining diagnostic criteria for 12 common conditions in the USA. Out of 16 published between 2000 and 2013, ten widened the definition, one restricted it and in five the impact was uncertain. An average of 75% of panel members had ties to industry and twelve of the panels were chaired by people with corporate links.

Population screening can also drive over-diagnosis and unnecessary treatment. Screening involves the *systematic testing of a defined and usually asymptomatic population* for a specific disorder. It can identify people at risk of serious diseases, such as cancer, who are not yet symptomatic. But there are downsides. Screening

Medical Nemesis.

- Streather: modern medicine does the most remarkable things, however there is a gathering sense that medicine is heading in the wrong direction.
- Nemesis: 'just indignation, righteous anger' .
- Hubris can be seen as a condition of excessive pride or one of a dangerous overconfidence.
- Medical nemesis a direct result of medical hubris.

The Jevons Principle/Paradox.

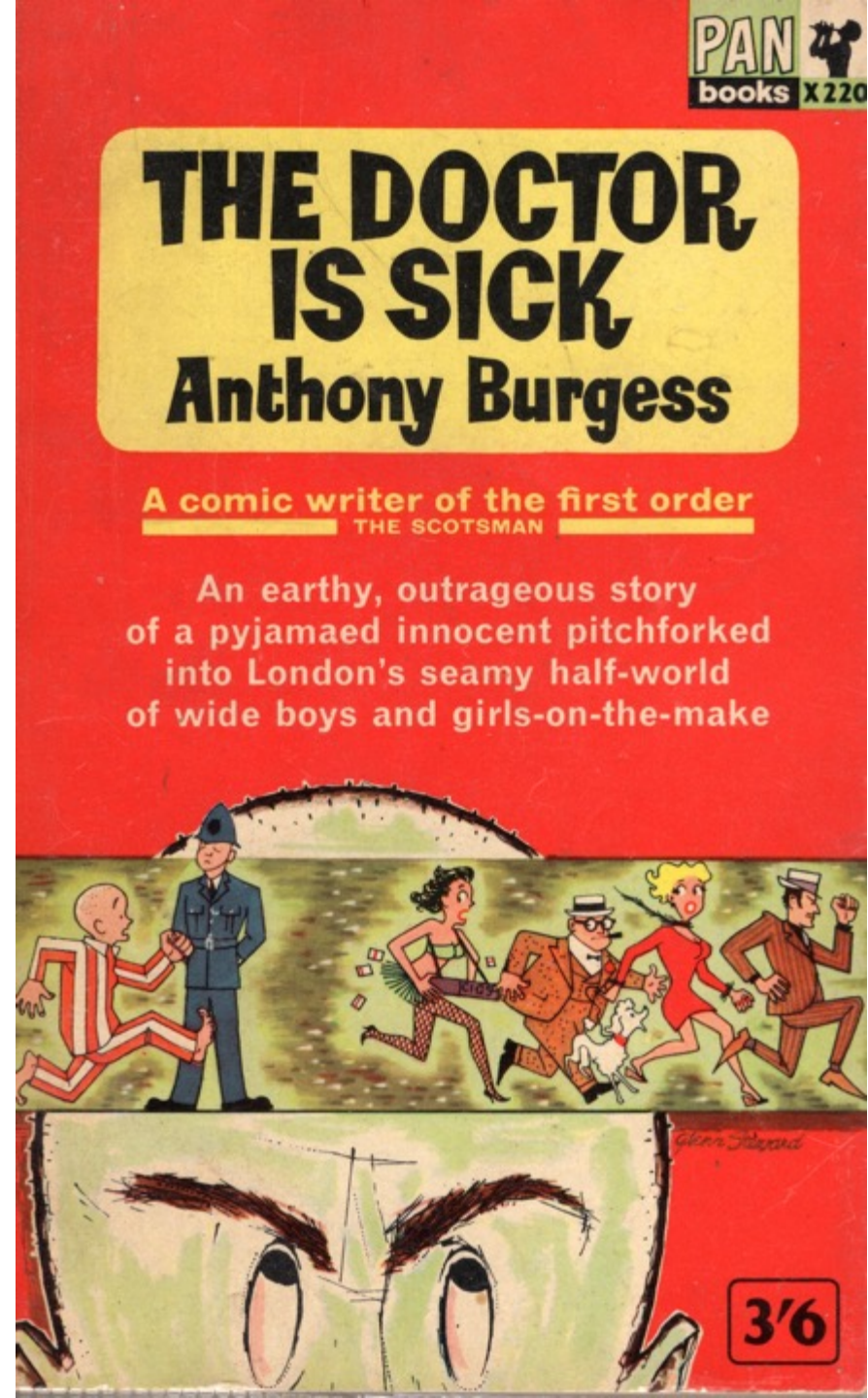
- William Stanley Jevons (1835-1882).
- In 1865, Jevons observed that technological improvements that increased the efficiency of the use of coal led to the increased consumption of coal (in a wide range of industries).
- So - and contrary to common intuition - technological progress will not necessarily reduce fuel consumption.
- Governments (and also environmentalists) believe that efficiency gains will reduce the consumption of resources (or the use of a service).
- I predict that the use of AI will increase overall activity.



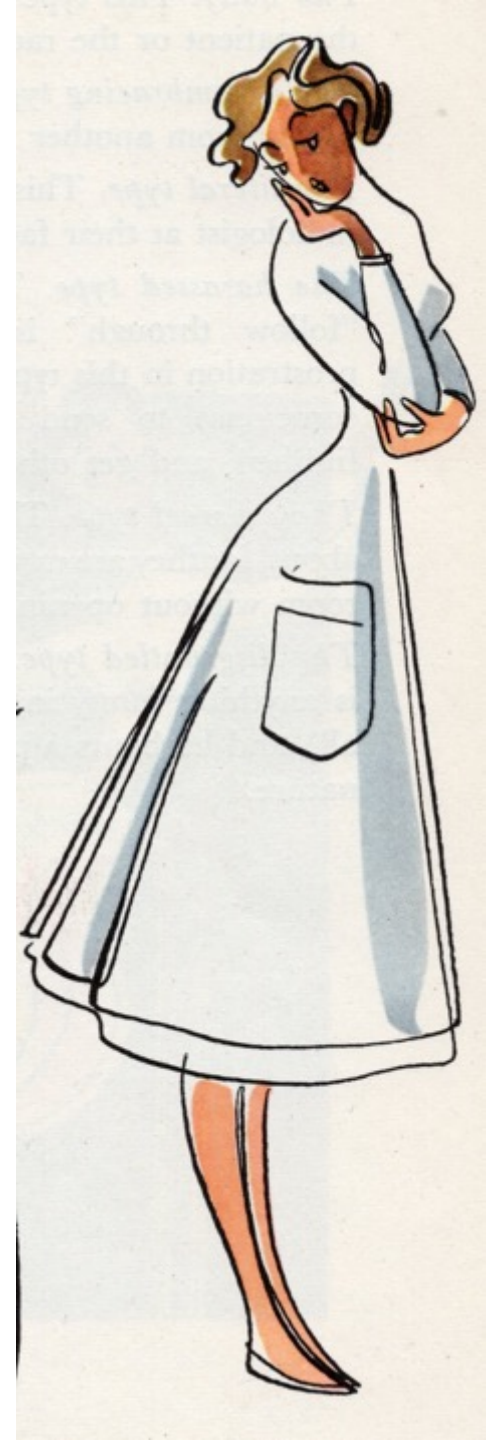
Anthony Burgess (1917-1993).



Anthony Burgess



- Edwin's skull X-rays were performed by one of the “crisply permed, white-coated young women who were jauntily self assured” and who deferred to no one.



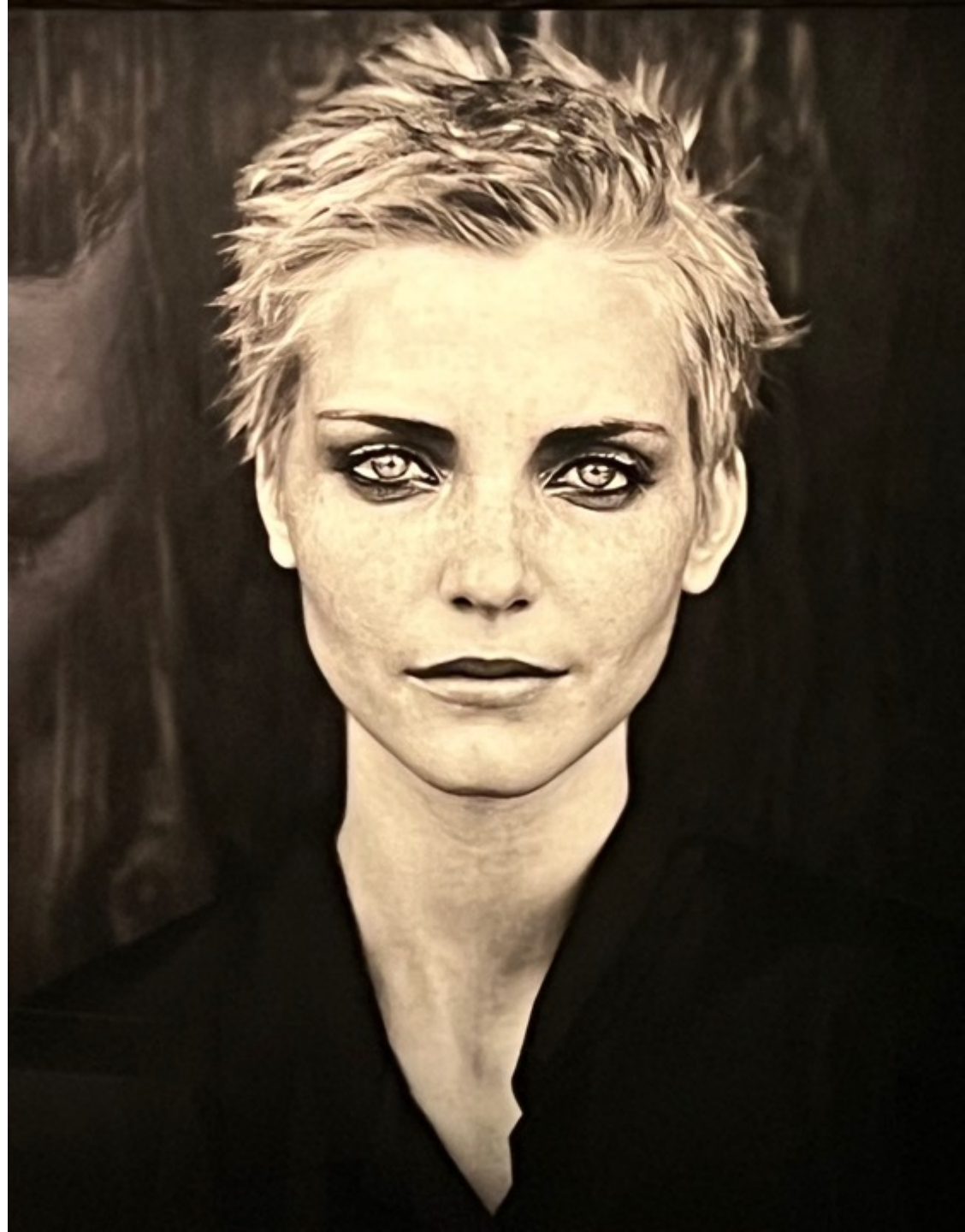
- Edwin's grinning skull was recorded.
- He commented to the radiographer that the poet Webster "saw the skull beneath the skin."
- T S Eliot (1885-1965) in *Whispers of Immortality* (sometime between 1915 and 1918) wrote:
- "Webster was much possessed by death, And saw the skull beneath the skin; And breastless creatures under ground, Leaned backward with a lipless grin."



Peter Lindberg: 'Lightness of Being' Stockholm.

16.06.2023 - 15.10.2023

- For me every photograph is a portrait; you are photographing a relationship with the person you are shooting; there is an exchange, and that's what the picture is.
- For me, black and white has always been connected to the image's deeper truth, to its most hidden meaning.

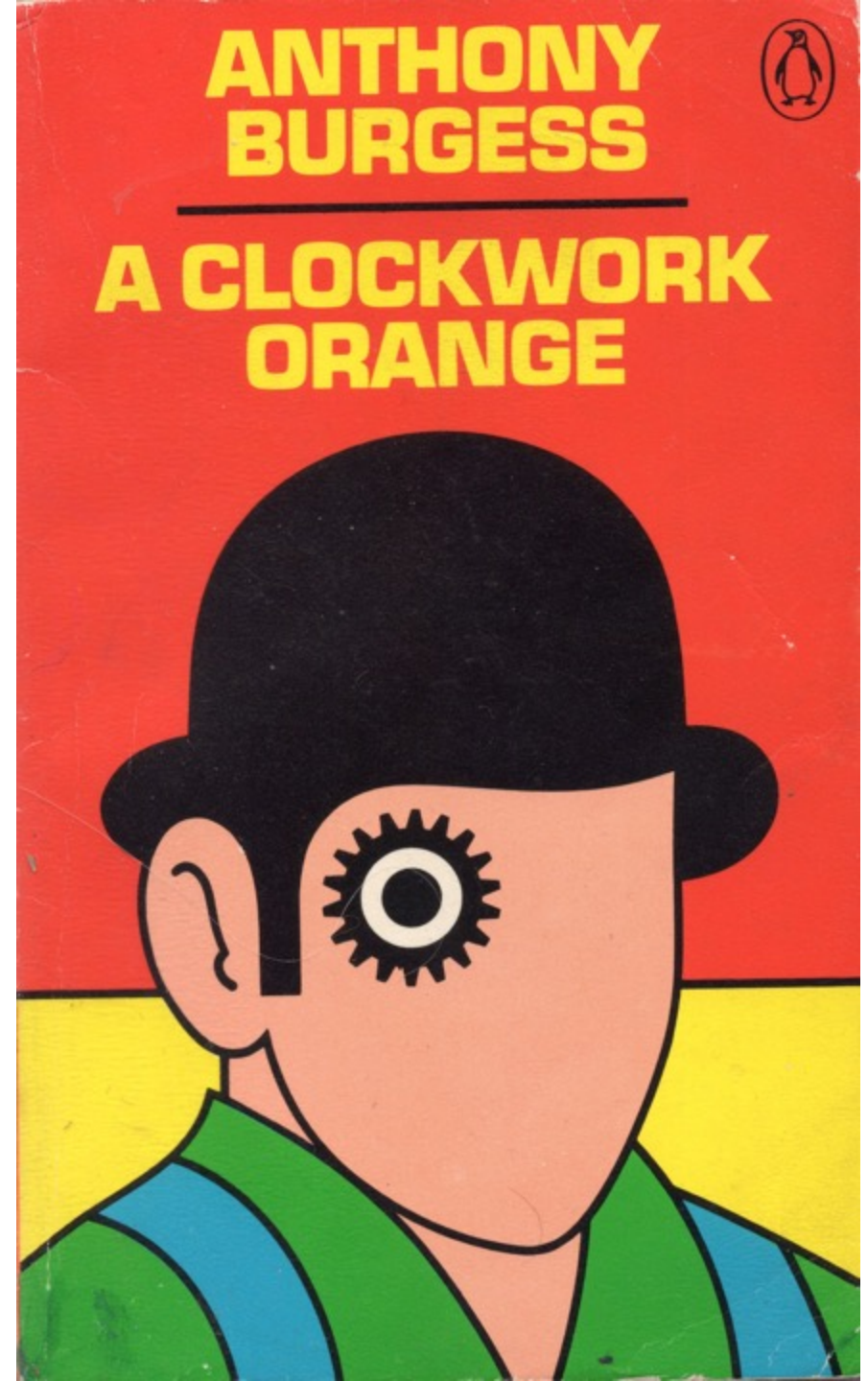


- The young woman thought it better to be a radiographer than a poet, since radiographers “save lives, don’t we?”
- Edwin wondered what was the purpose of saving lives, and what did she want people to live for?
- The radiographer replied that it was no concern of hers, and that anyway “That didn’t come into my course.”



- What meaning can medicine provide?
- The doctor might save lives, but what is then the purpose of life for the saved individual?
- The character of Alex in the novel *A Clockwork Orange* that Burgess published in 1962 is brought to mind.
- Alex is a violent and atomized individual that has little relationship with the wider society, and yet what meaning can the wider culture give to Alex? How different are those in authority from Alex? Is there more to life than *“let us eat and drink; for tomorrow we die.”*

Cover Design by David Pelham © Penguin Books, 1972.





Cerebral Arteriogram.

- Edwin “saw faces, upside down, peering at him incuriously.”
- The staff are not curious about him and chat about their own inconsequential matters ignoring Edwin.
- The test is a ritual, and the punctured artery likened to a snake that is caught, tamed, and force fed.

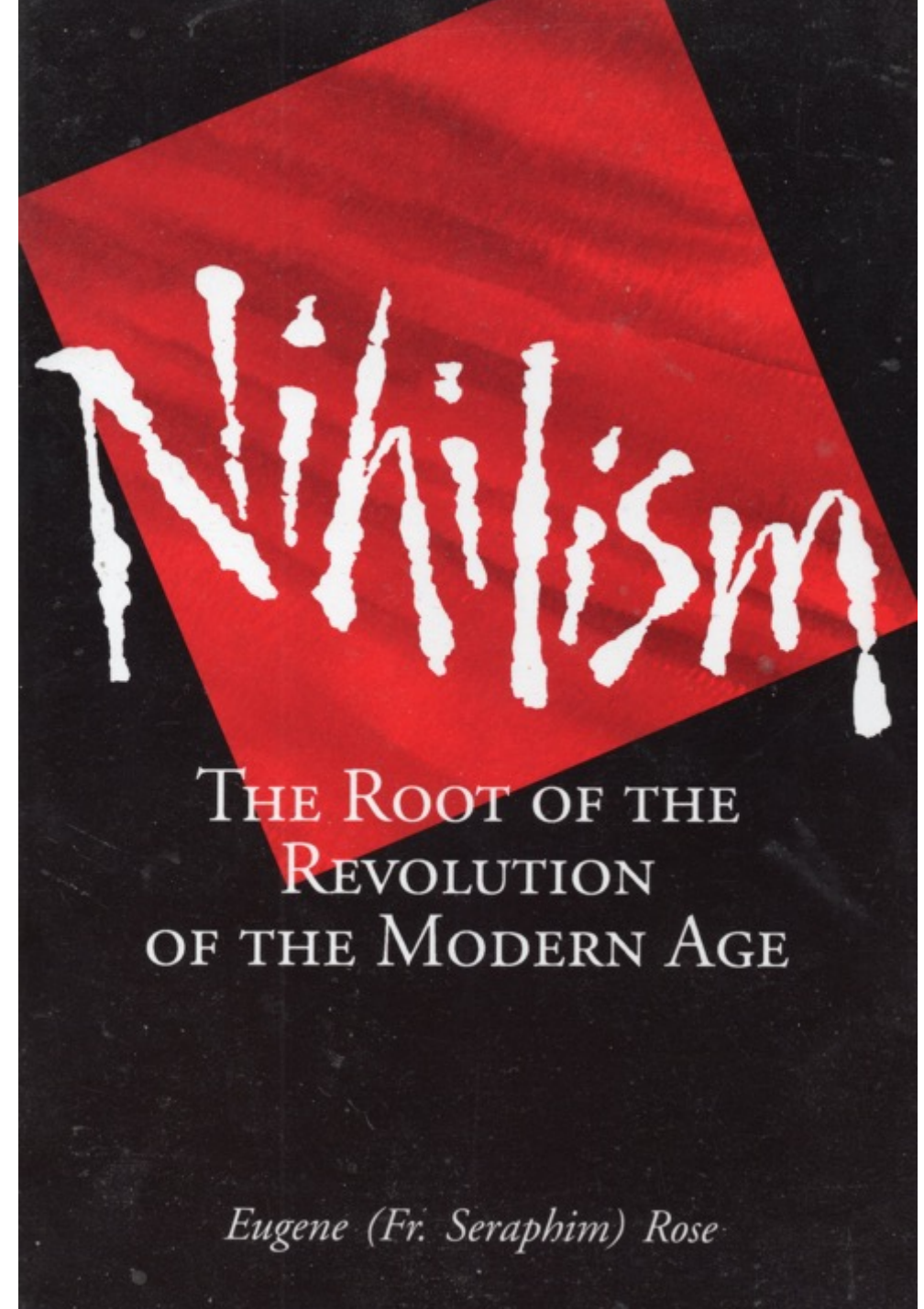
- “Between a thing and a thought.”
- Susan Aldworth.
- Intaglio print 20x20cms.
- Image courtesy of the artist.



Lumbar Air Encephalogram.

- During the lumbar puncture Edwin felt his vertebrae collapse as before, and that his life juice was splattered everywhere.
- In describing the procedure, he noted that the air entered coyly, easing its way up the bony chimney, splitting up into “quiet crocodiles tramping corridors they had never seen before”.
- Edwin thought that the staff resented his body and saw it like a potato that they were trying to roll around.
- He thought that it should be possible for the head to be removed and examined, and then afterwards reattached using an epoxy glue.

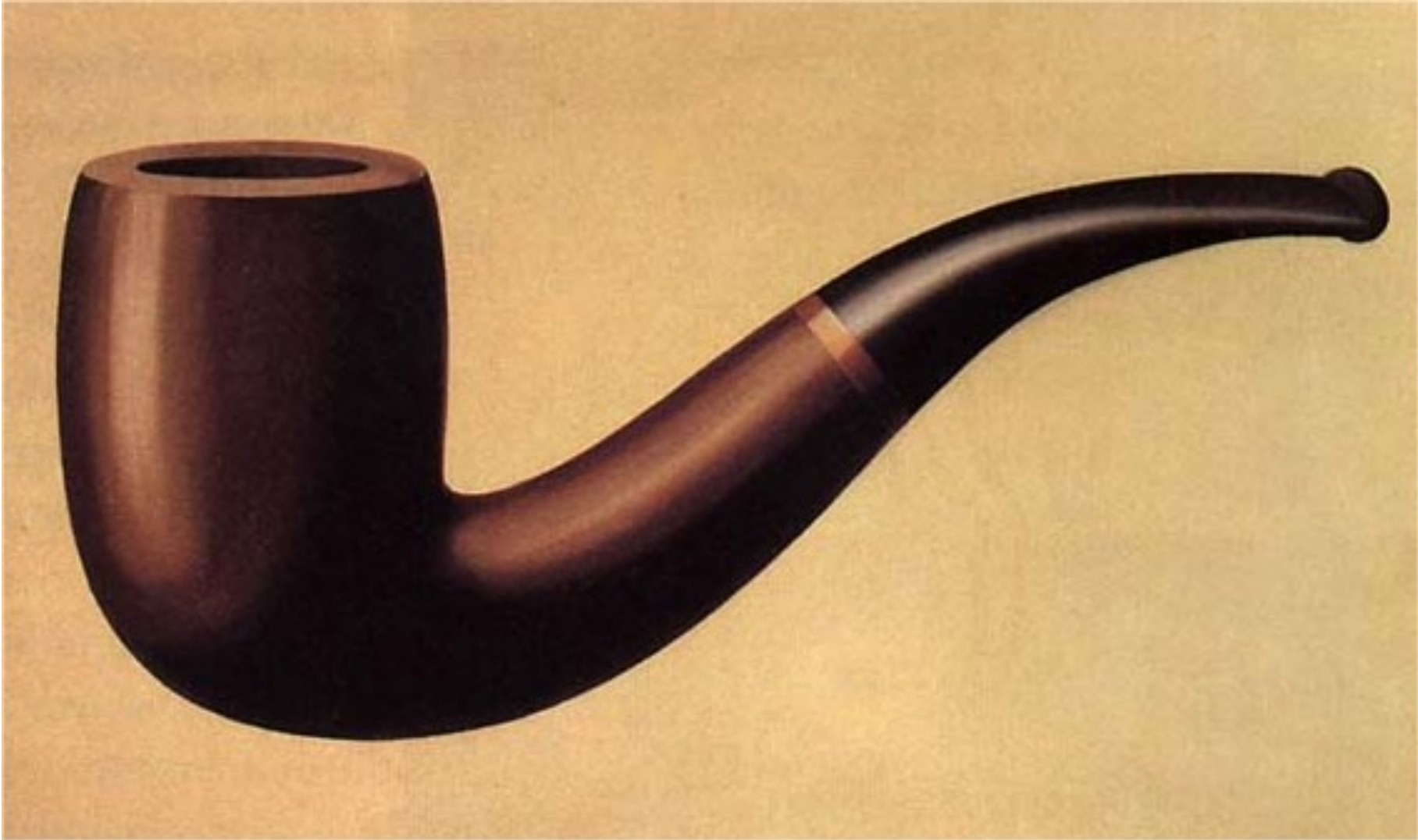
- Nihilism has been defined by the fount of philosophical Nihilism, Friedrich Nietzsche (1844-1900):
- “That there is no truth; that there is no absolute state of affairs – no ‘thing-in-itself.’ This alone is Nihilism, and of the most extreme kind.”
- *The Will to Power*, Vol.1, in *The Complete Works of Friedrich Nietzsche*, 1909.
- What does Nihilism mean? – That the highest values are losing their value. There is no goal There is no Truth, no ‘thing in itself.’ There is no answer to the question: ‘why?’”
- Quoted by Eugene Rose (1934-1982) , 1994.



Thoughts:

- The relationship between the patient, the image of the patient, and how the image is obtained is complex.
- The description by Burgess of being on the receiving end of medical imaging is a fascinating account.
- To obtain the correct balance between efficiently obtaining a diagnostic result of a complex study, and the patient not being simply a passive object is not an easy one, either then or now.

What is this?





Ceci n'est pas une pipe.

La Trahison Des Images
(The Betrayal of Images) 1929.
René Magritte





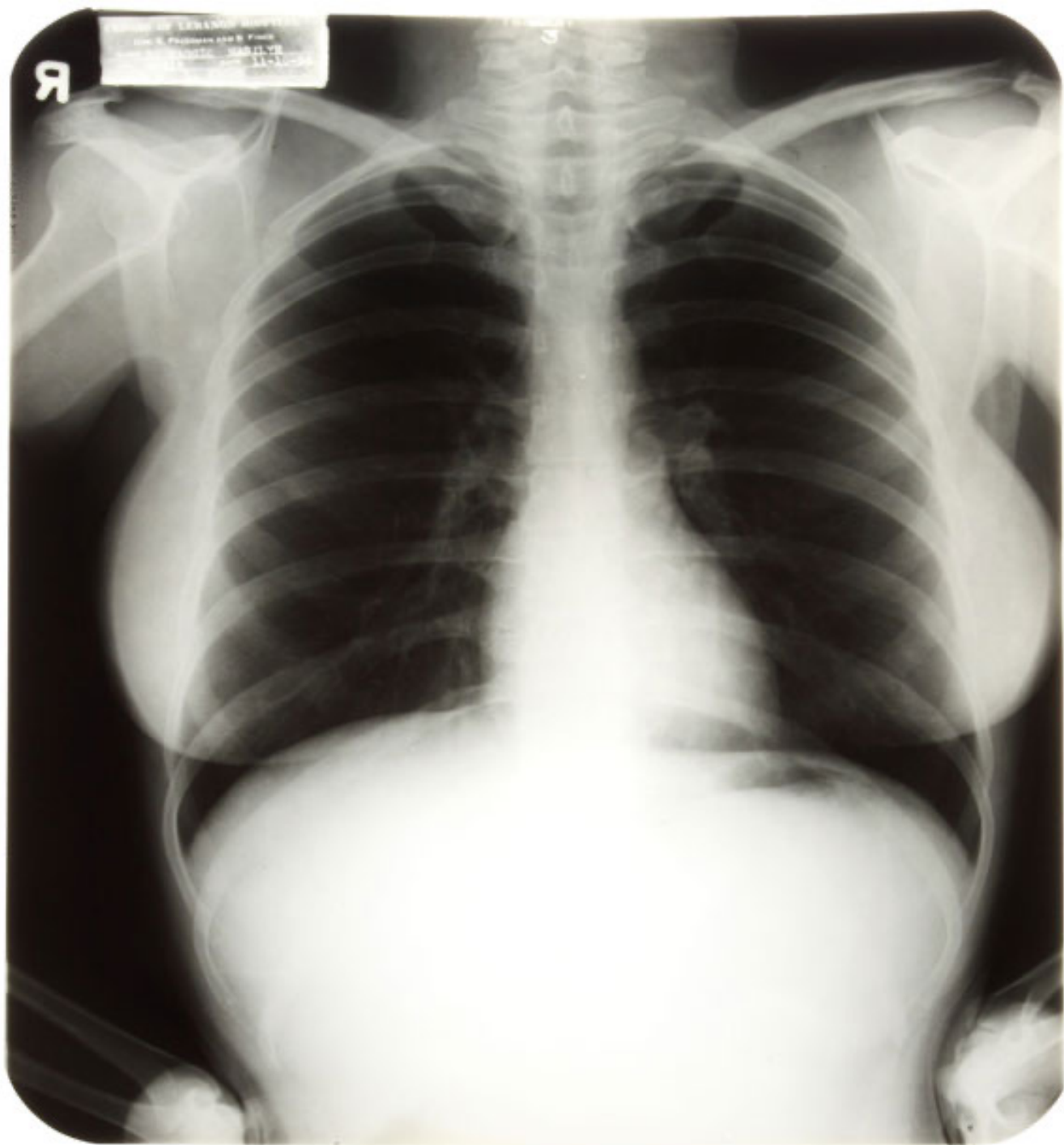
Ceci n'est pas un cerveau

un objet ne fait jamais le même
office qu'on nom ou que on imag





The
perfect
CXR?





How did it happen?

- Major changes over the years.
- X-ray photography has mirrored light photography.
- And what is the environmental impact of how it happened?

Radiomics.

- What are the limits of human comprehension?
- Radiomics extracts a large number of features from medical images using data-characterisation algorithms.
- These features potentially will uncover patterns and characteristics that fail to be appreciated by the naked eye.



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SUPERHUMANS: Chips inserted in brains will give us MIND-BLOWING abilities within years

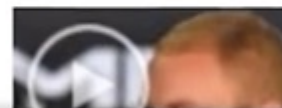
SUPERHUMANS: Chips inserted in brains will give us MIND-BLOWING abilities within years

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By SEAN MARTIN

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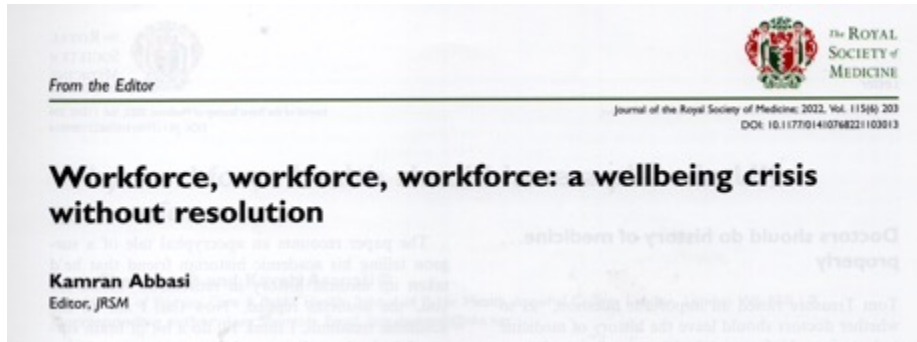
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GLAMOUR



Current stresses.



BURNOUT AMONG TRAINEE DOCTORS

Better pay could improve burnout

"Burnout" is now as much a part of my medical vocabulary as the language taught throughout medical school. Results from GMC surveys focus on what we already know (Seven Days in Medicine, 30 July), but the reaction will be what matters. The solution seems to be improving working conditions, but what about increasing pay?

Burnout is a state of physical, emotional, and mental exhaustion caused by long term involvement in demanding situations. If I spent less time worrying about paying rent or affording petrol, I would have more emotional and mental reserve. Perhaps I would be less likely to pick up a locum shift on my annual leave and more inclined to catch up on sleep after working 58 hours the previous week.

Burnout will continue until the workforce crisis is tackled. But better pay could be implemented comparatively quickly, and I would be intrigued to see the results.

Adam Darnley, foundation year 2 doctor, Manchester

Cite this as: *BMJ* 2022;378:o2118



Lack of empowerment harms trainees

The GMC's national training survey 2022 shows that, of the 76% of trainees who responded, 63% were at moderate or high risk of burnout. In addition, just over a quarter of trainees did not rate their training as good or very good (around a third in some specialties). These findings are related.

In our survey of 80 trainees in the Severn Deanery, the lack of empowerment caused by consultants making decisions without involving trainees (only a third had their findings verified regularly) meant that they did not have the opportunity to problem solve and get feedback on their clinical decisions. This harms team building, communication skills, and confidence building and increases burnout. Involving trainees and teaching at the bedside will reduce burnout because the task becomes relevant and purposeful. It will also reduce wastage of NHS resources because critical thinking reduces the blanket ordering of expensive and duplicate tests.

Parag Singhal, consultant endocrinologist, Weston-super-Mare; Davinder Sandhu, chair and associate dean, Antigua

Cite this as: *BMJ* 2022;378:o2120

10 September 2022 | thebmj

SEVEN DAYS IN

Burnout among trainees is at an all time high, GMC survey shows



Burnout among trainees and trainers has never been higher, the GMC has said, warning that NHS backlogs are threatening doctors' health and wellbeing.

The UK regulator's annual national training survey, completed by more than 67 000 doctors, shows a continuing worsening trend in answers about workload and burnout. It was completed by 76% of all trainees and 34% of all trainers in the UK.

Last year's report showed how the pandemic had reversed previous improvements, prompting the GMC to warn then that the changes should not become part of a "new normal." This year's report shows that the situation has deteriorated further. Charlie Massey, the GMC's chief executive, said, "Support for trainees and trainers must be at the heart of future workforce policy decisions, or we risk creating a vicious circle that, ultimately, will adversely affect patients."

Burnout was added to the survey in 2018, and this year 44 000 doctors completed the section. Two thirds of trainee doctors said they were "always" or "often" worn out at the end of the working day, and 44% said they were regularly exhausted in the morning, seven percentage points higher than last year. All specialties showed a rise in the proportion of trainees at high risk of burnout. The highest rate was in emergency medicine, with a third (32%) at high risk, an 11 point rise on 2021.

Jacqui Wise, Kent Cite this as: *BMJ* 2022;378:o1796

Current Issues.

- Increasing call for medical intervention.
- Relentless increase in demand. The Jevons' paradox.
- Scans to “rule out” (Medico-Legal pressures).
- CT brain is now part of “confusion screen.”
- Multiple investigations, duplications.
- CT/MRI/US duplication.
- Radiologists increasing separated from patients (many prefer to work from home).
- Increasing criticism of medicine: Vernon Coleman, Ivan Illich, James Le Fanu.
- Staff Burn-Out.

Embracing Change for a Bright Future.

- "If we constantly embrace change, rapidly adapt to innovations in technology and practice, react and respond to our inflection points, remain vigilant and maybe even a little bit paranoid, radiology will most certainly enjoy a robust, exciting and bright future."
- RSNA President, Matthew A. Mauro, President's Address.
- RSNA 2023: Sunday, November 26

Two Paradigms.

Traditional.

- Minimally Invasive / Invasive Diagnosis.
- Invasive Therapy.

Contemporary.

- Non-invasive diagnosis.
- Minimally invasive Therapy.

Aristotle: 6th book of *Nicomachean Ethics*

- Discusses the intellectual virtues: distinguishes between *sophia* and *phronesis*.
- *Sophia*: theoretical wisdom, knowledge that is logical and can be taught, and resonates with the discipline of science.
- *Phronesis*: the supreme intellectual virtue, practical wisdom, which is reasoned, and is capable of action with regard to the things that are good or bad for us.
- *Phronesis* is about living well, that is living the good life, and in harmony with our environment.
- It is a skilled deliberation, and has an ethical significance. With a combination of theoretical and practical wisdom radiology and the BIR can look forward to a positive future.

Invisible Light,
The Remarkable Story of
Radiology.

(2022)

Thomas, Adrian.

Boca Raton: CRC Press (Taylor
and Francis Group). A fully
referenced account of the
development of radiology.

Adrian Thomas © 2023

