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International Journal of Urologic History

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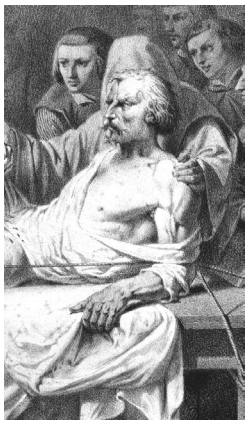
Praeterito Docet

'The past teaches'

On the Cover



The tale of the Archer of Meudon, an apocryphal account of live surgery without anesthesia in 15th century Paris, lived long in French lore. Investigative history, however, requires the scholar to locate and scrutinize original texts to confirm fact from fiction. During the reign of Louis XI (1423 – 1483), an archer from Meudon was condemned to death for theft and various crimes in 1473. Ha et al. reviewed the original documents describing the event by the contemporary historian, Enguerrand de Monstrelet.(1) "The court dismissed (the archer's) appeal" wrote Enguerrand 500 years ago "and confirmed the sentence… of execution. But the surgeons and physicians of Paris petitioned the king that as a variety of persons were afflicted with the stone and other internal disorders and that this franc-archer had complaints similar to those of which the Lord de Bouchage (a counsellor to Louis XI) now lay dangerously ill, it was requisite that the internal parts of the living man should be examined and that no better subject could have offered than this franc-archer under sentence of death. The physicians and surgeons in consequence of the king's permission opened his body- and having examined his bowels replaced them and sewed up the body. By the king's orders, every care was taken of him and within 15 days he was perfectly cured and was not only pardoned for his crimes but had a sum of money given to him."(2) Ha et al.'s research found, however, no official record of the surgery in the Paris Faculty of Medicine nor in any other surviving royal document and that the Enguerrand document provided no actual details as to bladder or kidney stone. A later text by François de Mézeray in Histoire de France falsely documented the surgery as the first pyelolithotomy. (1) The image of this month's IJUH cover, a fanciful 1851 depiction of the surgery by Antoine Rivoulon (1810-1864) even names the surgeon as Germain Colot and location, but reminds the reader that supposed 'facts' may, with careful reanalysis, be more tale than truth.(3)

1. Ha A, Badalato G. The Archer of Meudon: The myth of the first pyelolithotomy. J Urol. 2022; 207: e218. doi.org/10.1097/JU.0000000000002541.20
2. The chronicles of Enguerrand de Monstrelet, trans. Johnes, Thomas (1748-1816) vol 2 London, H. G. Bohn, 1853. P412-413. https://catalog.hathitrust.org/Record/011536378/
3. "Earliest operation for the stone performed in presence of King Louis 11th by Germain Colot in the Cemetary of St. Severin, January 1474", Antoine Rivoulon (1810-1864), 1851.(Public domain. wellcomecollection.org/works/p5k8hq5v)

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The Ileal Ureter: Over a Century of Urologic Innovation

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Introduction: Surgical techniques to repair a ureteral stricture may depend on the stricture's etiology, length, and location. Options may range from primary ureteral reimplantation for short, distal strictures, buccal mucosa onlay ureteroplasty for complex proximal or mid ureteral defects, to Boari flap or even autotransplantation for longer mid to distal ureteral defects. Replacement of the entire ureter with a segment of ileum is rare but may provide durable results when indicated. Our objective was to illustrate how the history and evolution of the ileal ureter entered the contemporary surgical armamentarium.

Sources and Methods: A comprehensive literature review was performed in conjunction with library resources in the History of Medicine section at the University of Rochester. We used PubMed to identify contemporary medical literature, ILLiad to access archived texts and historic surgical and urological textbooks to obtain additional historical information and references.

Results: We documented perhaps the first description of the ileal ureter in a canine model by Guido Tizzoni and Alfonso Foggi in 1888. Adaptations of ileal ureters over the next century, and beyond, have increased the safety, feasibility, and reproducibility of thre procedure for replacement of the ureter rendered unsalvageable by strictural disease, trauma, or malignancy.

Conclusions: Tizzoni and Foggi described the first ileal ureter in the canine model in 1888.

Keywords: Ureter, Ureteral Diseases, Reconstructive Surgical Procedures, History of Medicine

The surgical treatment of complex and long ureteral strictures failing conservative management has been a challenge for urologists given the unique vascular and structural characteristics of the ureter. Several methods to address structural disease of the ureter have been described including transureteroureterostomy, renal autotransplantation, cutaneous ureterostomies, and augmented ureteroplasty with buccal graft, each having its own associated complications. Ureteral replacement with ileum may be a 'last-resort' method for ureteral injuries but which dates to the late 19th century. (1, 2) The origin of the ileal ureter procedure and its subsequent improvements have not, however, been well documented. We aimed to review the history of the ileal ureter and its evolution.

SOURCES

A comprehensive literature review was performed in conjunction with the University of Rochester's History of Medicine librarian (LH). We used PubMed to identify contemporary medical literature, ILLiad to access archived texts, and urological textbooks to obtain additional historical information and references.

RESULTS

Origin of the Ileal Ureter

In the late 19th century, surgeons experimented with various diverting techniques to combat urinary injuries that compromised ureteral continuity.(3, 4) Ureterointestinal anastomosis such as ureterosigmoidostomy was used during this period but was complicated by hydronephrosis secondary to distal ureteral stenosis, infection, and the later development of colon cancer. (3, 5) Ureteroileoplasty was also attempted, where the ureter was anastomosed to a segment of ileum and then the distal end of the ileal segment attached to the rectum. Bowel was chosen as a ureteral substitute because is unidirectional peristaltic characteristic would theoretically prevent reflux and subsequent hydronephrosis.(6) Yet, this led to similar concerns including malignancy and recurrent infections due to retrograde migration of bacteria from the intestinal tract. Such techniques were indicated for patients who

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had undergone cystectomy but may have been the nidus to consider ileum for ureteral substitution as well. The use of ileum to replace ureter and maintain urinary continuity was first proposed in 1888 by two Italian surgeons, Guido Tizzoni (1853-1932) and Alfonso Foggi (1848-1934), in a two-stage canine model.(5) In the first stage, a seven-centimeter segment of ileum was isolated with its attached mesentery. Each end of the segment was sutured closed and then the segment left freely in the abdomen. After a month, a cystectomy was performed and the ureters were anastomosed to the proximal end of the isolated bowel. The distal end of the ileal segment was anastomosed to the urethra. (7) Renderings of Tizzoni and Foggi's method were not well documented and were only made known through subsequent publications by colleagues of Tizzoni and Foggi. These reported that only a partial cystectomy was done, and the substituted ileum was attached to the remnant portion of the bladder as opposed to the urethra (Figure 1).(8) Regardless, their studies demonstrated the first model use of bowel to maintain urinary continuity following ureteral loss.

In 1893, Christian Fenger (1840-1902), a surgeon at Northwestern University, proposed the use of bowel in ureteral reconstruction in a personal conversation with Weller Van Hook.(9, 10) This concept was later published by Joseph Bacon (1854-unknown) in the Chicago Medical Record, who suggested isolating a small ileal segment with its maintained blood supply and anastomosing it to the ureter proximally and bladder distally (Figure 2).(9, 10) The contemporary critiques of this idea highlighted problems that still challenge urologists to this day: seeding of infection from the transposed bowel, complications of bowel manipulation, and a lengthy recovery.

First Application in Humans

The first successful *in vivo* case of an ileal ureter was reported by American surgeon George Shoemaker (1857-1922) in a woman with tuberculosis who had previously undergone unilateral nephrectomy and subsequently required surgical intervention when her solitary ureter became strictured.(11) The procedure was performed using a two-stage technique. First, the strictured ureter was replaced with an isolated segment of ileum. The proximal end was attached at the renal pelvis, and the distal end of the ileal ureter was brought to the skin as a uretero-ileostomy. In the second stage, urinary continuity was re-established as the distal end of the ileal ureter was anastomosed to the bladder. Unfortunately, the long-term outcome was not described in the case report.

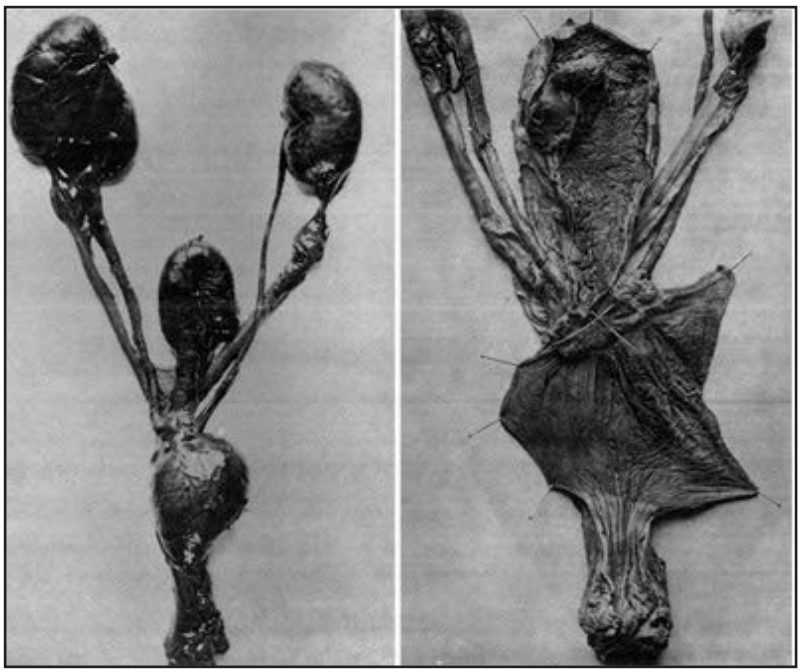

Figure 1. Depictions of the first documented use of bowel in urinary tract surgery based on the work of Tizzoni and Foggi in 1888. The photo, from the 1891 paper by Schwarz et al. describing their work, shows enlargement of an isolated segment of ileum transplanted onto bladder in the immediate post op (left) and delayed (right) in a dog models(8)

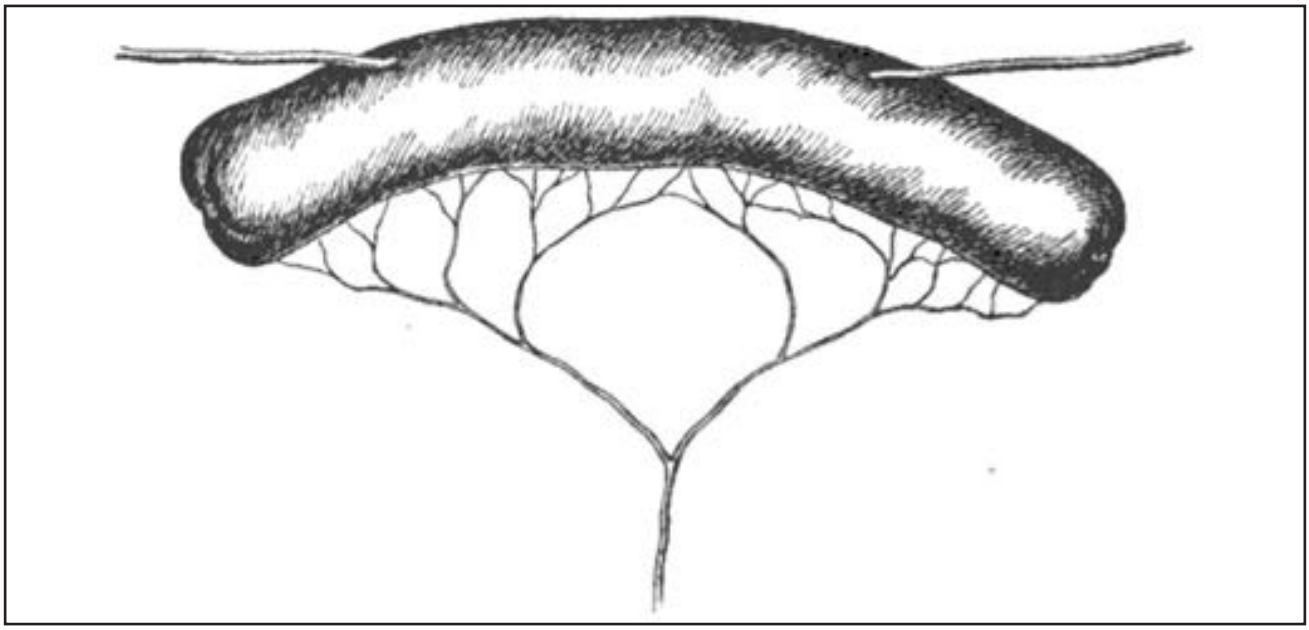

Figure 2. Joseph Bacon was the first to propose the use of small intestine in ureteral substitution in humans through isolating a small bowel segment with its maintained blood supply. Chicago Medical Recorder. 1893.(9)

Development of the Ileal Ureter after Shoemaker

Dr. Shoemaker's technique became the basis of the modern ileal ureter. Rudolf Nissen (1896-1986), a German Jewish surgeon best known for developing the Nissen fundoplication procedure, fled Nazi Germany and emigrated to Turkey, where he later became the Chief of Surgery at Istanbul University. During his tenure there (1933-1939), he described a patient with a history of bilateral obstructing renal calculi who underwent multiple ureteral catheterizations.(12) Following the last ureteral catheterization, a large "paraureteral abscess developed", which was complicated by a urine leak and ureteral fistula. Additional attempted catheterizations to reestablish ureteral continuity were unsuccessful. Thereupon, Nissen decided to complete a continent ureteral reconstruction as a last resort. Initially, a small bowel segment was isolated, and the distal end was attached to the dome of the bladder via a side-to-side anastomosis. The proximal end of the ileal segment was anastomosed to the ureter using the "Witzel technique", an anti-reflux technique in which the ureter is anastomosed in an end-to-side fashion to the ileum and then embedded in a seromucosal tunnel of the bowel using interrupted sutures.(Figure 3). The operation was successful, and the patient was followed for over six years without complications.

In 1944, French surgeon Yves-Jacques Longuet (1901-1989) operated on a woman who had previously undergone a hysterectomy and subsequently developed bilateral ureterovaginal fistulae.(13) Initial management with stents was unsuccessful due to "considerable diminution of the outflow" of the left ureter and that he found it "impossible to pass the catheter" up the right ureter. Over time, right hydroureteronephrosis developed leading to renal atrophy. A section of small bowel was isolated, and then the midpoint of this segment was attached to the bladder dome, creating a U-shaped anastomosis. The right ureter was anastomosed to the ileal segment, and then the ends of the ileal segment were anastomosed together to prevent formation of a cul-de-sac for stagnant urine. In 1950, Von K. Müller-Brandenburg, a German urologist, attached the ureters to a loop of ileum that was anastomosed to the bladder in a woman with bilateral, iatrogenic ureteral injuries secondary to gynecologic surgery for uterine malignancy.(14)

In 1953, Foret and Heugshem from Belgium used a single ureteral substitution in a 29-year-old woman with bilateral hydronephrosis secondary to distal ureterovesical stenosis. Each ureter was anastomosed end-to-end to either end of the ileal segment, and then the middle of the segment was anastomosed side-to-side to the dome of the bladder.(15)

These case reports demonstrated the diverse and innovative thought processes of reconstructive urologists during this time.

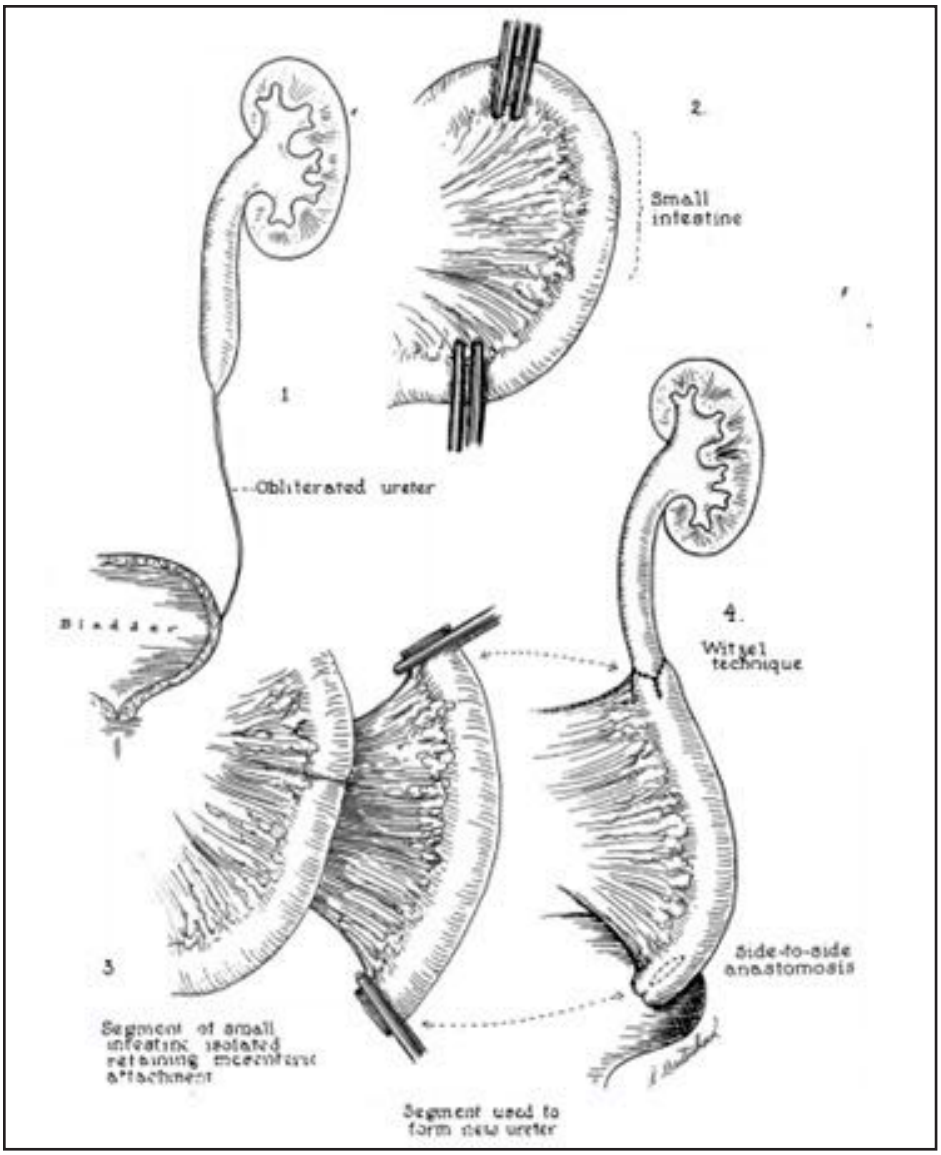

Figure 3. Following the first reported case of the ileal ureter by Shoemaker, Rudolph Nissen in 1940 was the next to describe a detailed report of using ileum in a proximal end-to-side fashion via the Witzel technique and distal side-to-side anastomosis to the bladder. From Nissen et al.(12)

The First Large Cohort Study

Charles Wells (1898-1989), a Liverpool surgeon, presented a 395-patient case series on the use of bowel in urologic surgeries, to the British Association of Urological Surgeons in 1956.(16) This study included patients with uretero-ileostomy, uretero-ileoplasty, and ileo-cystoplasty. Within the uretero-ileoplasty series, 56 patients underwent either partial or total ureteric replacement with ileum. Wells looked at several outcomes including all-cause mortality, improvement in pre-operative hydronephrosis, and general post-operative quality assessment. The mortality rate was 7.0%, with most deaths occurring in the hospital immediately post-operatively. In patients with preoperative hydronephrosis, 60% (6/10) had improvement at three to six months post-operatively,

and 66% (2/3) showed improvement after six months. General assessment at an average of 12-month follow-up showed high satisfactory outcomes. Two patients reported worse outcomes secondary to renal failure and prostatic obstruction.

Wells also reported that patients with cutaneous uretero-ileostomies had less urea and chloride reabsorption compared to patients who underwent uretero-ileoplasty and ileo-cystoplasty (Figure 4.) He concluded that the ileal mucosa had a propensity for urea and chloride reabsorption due to prolonged urine exposure to ileal mucosa in the uretero-ileoplasty and ileo-cystoplasty groups. This finding was one of the first to raise concern regarding the metabolic derangements associated with the use of bowel in ureteral reconstruction.

The UCLA Impact on the Evolution of the Ileal Ureter

In 1959, Willard Goodwin (1915-1998) and colleagues at the University of California at Los Angeles (UCLA) published a series of 16 patients who had undergone ileal ureters and described in detail the surgical technique and outcomes of each patient.(17) They reported six different technical variations of the surgery including unilateral end-to-end ileal ureters (Fig. 5). Three of 16 (19%) outcomes were deemed failures. Two of the three were due to poor preoperative renal function, leading to uremia and acidosis postoperatively requiring ileoureterostomy for urinary diversion. The third failure was due to a vesicovaginal fistula that was present prior to the surgery. In this case, the ureteral replacement was a success, but persistence of the fistula necessitated cutaneous uretero-ileostomy.

Goodwin was the first to appreciate the concern of ileo-ureteral reflux. He noted that the peristaltic effects of the ileal segment most often prevented reflux, but fluorographic and pressure studies demonstrated that high bladder pressures transmit through the ileal ureter into the kidney. Goodwin also noted the relationship between optimal ileal segment length and reflux, as patients with segments that were too long or too short resulted in excessive metabolic complications or reflux, respectively. The UCLA group reported the variety of indications for ileal ureters including extensive damage from gynecological oncologic resections, solitary kidneys, and renal calculi. These findings paved the way for urologists to utilize these techniques in the repair of damaged ureters.

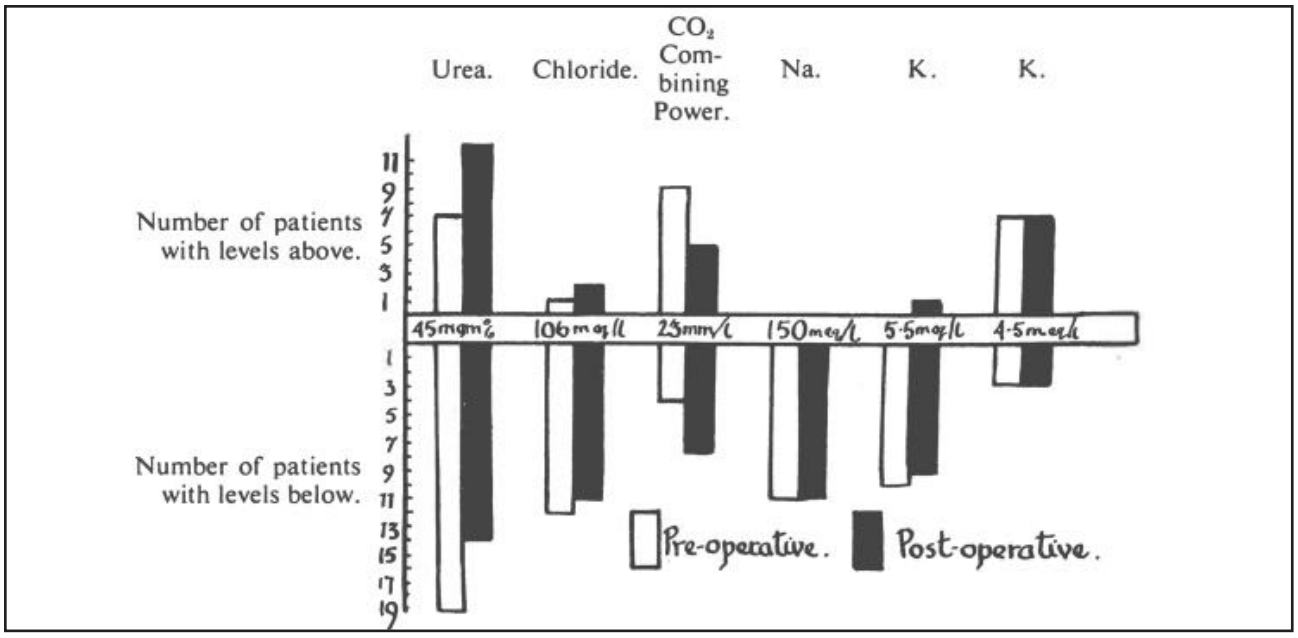

Figure 4. As the use of bowel proved a feasible option for ureteral substitution, Charles Wells published the first large cohort studies demonstrating the metabolic derangements associated with this technique such as increased urea and chloride absorption. From Wells et al.(16)

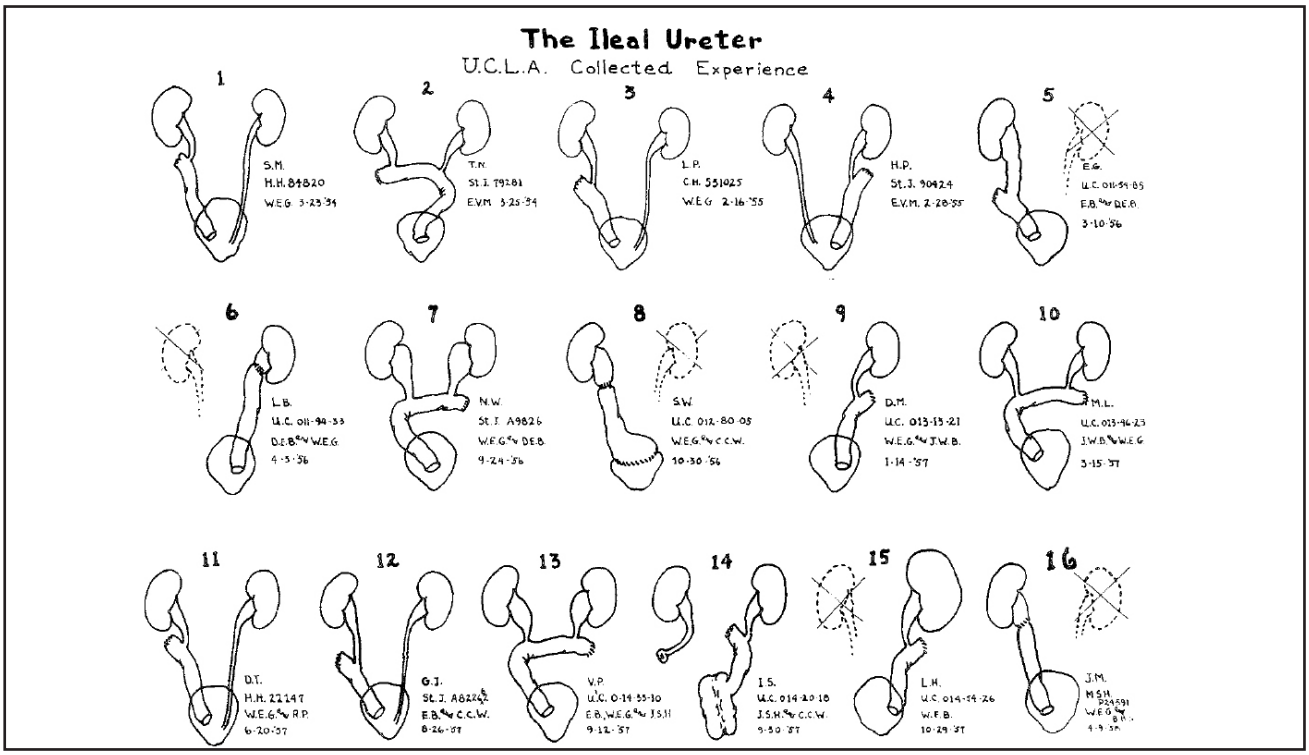

Figure 4. Willard Goodwin, a renowned urologist from UCLA, published a case series on the ileal ureter that were completed by urologists within his department. There are several variations shown, including different ureteral-bowel anastomoses and techniques for bilateral ureteral strictures. This also highlighted several technical and post-operative challenges of the use of bowel. Goodwin. J Urology. 1959.(17)

Continued Challenges of the Ileal Ureter

1) *Metabolic Derangements*: One of the major concerns regarding the use of bowel in ureteral reconstruction is its resorptive nature. In 1985, Boston urologists Michael Koch and W. Scott McDougal reported significant chloride, potassium, and ammonia reabsorption within the ileal segment.(18) Alterations in serum ammonia levels changed the body's normal buffering system, leading to acidosis. Furthermore, they found that these metabolic derangements were exacerbated in patients with preexisting renal impairment and bladder dysfunction. This established that a baseline serum creatinine greater than 2 mg/dL, and underlying inflammatory bowel disease (IBD) may be contraindications for neobladder reconstruction surgery, which remains today as a guideline. Interestingly, newer studies have shown that patients with advanced chronic kidney disease that underwent an ileal ureter had improved creatinine and eGFR despite having elevated preoperative creatinine.(19)

2) *Ileo-ureter Reflux*: Some studies postulated that reflux is present in a significant portion of ileal ureter patients but the clinical effect of reflux remains controversial.(20-22) In 1979, Richard Boxer, Donald Skinner, and colleagues at USC published that 74 of 89 (83%) patients who underwent ileal ureter had reflux, but serum creatinine was unchanged or improved in these patients upon follow up.(20) Various anti-reflux methods including the ileal-psoas tunnel(22), Yang-Monti(23, 24), and distal nipple techniques(25) have been proposed to reduce potential complications from reflux but increased the risks of ureteral obstruction.

3) *Mucous plugs:* To reduce the rate of mucous plugging, Dutch urologist Peter van Helsdingen and colleagues in 1984 used intraoperative dissection to resect the bowel mucosal layer in animal models.(26) However, this led to increased ureteral stricture rates. In 2017, Lujia Zou of Shanghai, under the guidance of Haowen Jiang and colleagues, attempted to use submucosal intestinal tissue to compensate for increased stricture risks but development ischemic inflammation.(22, 27)

Advancement of Minimally Invasive Techniques

The development of laparoscopic and robotic approaches have allowed the application of minimally invasive techniques to reconstructive urology and ureteral replacement surgery. Surgeons have described that the use of the Da Vinci robot, with its three-dimensional visualization of the surgical field, improved ergonomics, and enhanced hemostasis is applicable to ureteral replacement and ileal surgery.(28)

In 2000, Gill and associates reported the first 'straight' laparoscopic ileal replacement surgery in a patient with a solitary left kidney and a left sided ureteral urothelial carcinoma. The patient underwent left ureteral resection and ileal ureteral replacement. Total operative time was eight hours with an estimated blood loss of 200cc.(29) The first robotic-assisted ileal ureter in 2008 was reported by Joseph Wagner and colleagues from Hartford, Connecticut.(28) In this case, the robot was used for the initial ureter resection, undocked to allow for laparoscopic isolation of the ileal segment, and then redocked to the field to complete the ureteroileal and vesicoileal anastomoses. In 2014, Luis Brandao and associates in Cleveland, Ohio described the first completely intracorporeal robotic technique followed by subsequent series by other authors.(30-32) Limitations to the robotic approach included significant operative times, extended manipulation of bowel, and difficulty with bowel anastomoses which improve with surgical experience.

CONCLUSIONS:

Treatment of ureteral strictures ranges from natural orifice (i.e. transurethral) minimally invasive, endoscopic techniques to complex reconstructive surgeries with bowel substitution. The ileal ureter provides an option for long segment ureteral strictures. The modern ileal ureter utilizes techniques similar to those described more than a century ago. While the complications associated with this procedure are important to consider, they have led to novel surgical advances and continue to evolve

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First Sex- The Natufian Statue and Professor Dorothy Garrod

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Introduction: Our knowledge of the social structure of pre-historic peoples is limited by the scant physical record, largely limited to archeological fragments of biological materials, tools, and funereal art. The Natufian, who lived near present day Jerusalem around 9000 BCE, was a culture first identified by Dorothy Garrod, a British paleo-archeologist. The Natufian produced what may be the world's first expression of sexuality in art in the Ain-Sakhri statue, depicting two figures intertwined in a coital embrace. Our aim was to better illustrate Garrod's seminal work, and the significance of the Ain Sakhri statue in our understanding of pre-historical concepts of sexual self-awareness.

Sources and Methods: Archives of the British Museum (London), the Pitts River Museum and the Dorothy Garrod Photographic Archive (Oxford), the Mathurin collection at the Musée des Antiquités Nationales (St Germain-en-Laye, France), and digital.humanities.ox.ac.uk were consulted to identify biographical information on Dorothy Garrod and her archeological work. Secondary sources on the Natufian peoples and their art were identified through PubMed, digital archive sources, and the Garrod archives as cited.

Results: Dorothy Garrod (1892-1968) was a prolific early 20th century scientist in paleo archeology and a pioneer for women in a male-dominated field, the first prehistorian, and first woman, to be elected to a professorship at Cambridge University (1939-1952). She established comprehensive excavations in the Levant in the Middle East on Mount Carmel near Jerusalem where she identified the ancient Natufian cultures. There, her mentor, AH Breuil, had found a 10 cm stone figure, now known as the 'Ain Sakhri' figurine, from 9,000 BCE and identified by him to be a product of Garrod's Natufian culture. Unlike other contemporary Natufian sculptures found in the Wadi Khareitoun region, which were worked in bone or antler, the Ain Sakhri was chiseled from calcite. The Ain Sakhri, depicting two intertwined figures and with a phallic shape, is regarded as the world's oldest known sculpture of people making love.

Conclusions: Dorothy Garrod was a ground-breaking pioneer in paleo archeology and the 1st female professor at Cambridge from 1939-1952. Her early 20th century work on the Natufian people revealed a complex, sophisticated pre-historic culture which produced the Ain Sakhri, the first sculpted depiction of coitus, predating the historical record of sexual self-awareness by thousands of years.

Keywords: Natufian people, Ain-Sakhri, Dorothy Garrod, the Levant, Paleolithic archeology

Self-awareness and the origin of human sexuality is linked to the development of mankind itself, well documented by modern genetic paleoanthropological investigations into mitochondrial Eve and Y-chromosome Adam.(1) The hominid lineage has recently experienced a modern Renaissance with rapid expansion in our genetic knowledge about its evolution within Africa, first hypothesized by Charles Darwin.(2) Descendents of *Homo neanderthalis* and *Homo erectus*, the two surviving species of the Lake Toba supereruption of 74,000 BCE, migrated to settle in the fertile lands of the Mid Eastern 'Levant' region in present day Israel.(3) The archeological evidence of cultures in the Fertile Crescent before 3000 BCE is scant, largely derived from analyses of bones, shards, funereal garments, and artwork. How these people lived, and how they thought of themselves in the world, is similarly vague having existed thousands of years before the earliest hieroglyphic or Sumerian writings.

The earliest archeological excavations in the region were undertaken by western historians including Dorothy Garrod and her mentor Abbe H Breuil, a wily spelunker and Cambridge don who was said to "explore impossible caves in a Roman collar and bathing dress".(Figure 1)"(4) Garrod was the daughter of a physician and a family of scientists, traveling early in life to the Mediterranean, and being amongst the first in Britain to study paleo-lithology, the study of ancient

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rocks and rock sculpture. Garrod excavated many sites in the Middle East and discovered the Natufian culture, peoples who had settled in an area outside present day Jerusalem about 15,000 BCE- 11,500 BCE. Garrod's comprehensive efforts led to the preservation of many tools, objects, and skeletal remains that greatly advanced the understanding of Natufian social structures. Breuil found in the area a small statuette sculpted out of calcite, correctly identified as Natufian in origin, and named 'Ain Sakhri' after the cave in which it was found.(4) The small object depicts two intertwined, human figures engaged in an embrace. "The faces are featureless, the heads being distinguished by a groove both in the outline of the sculpture and on the broad surfaces."(6) The stone, and many of Garrod's photographs and findings, were eventually donated to museums in Britain and France but the Ain Sakhri retained a special significance. Our aim was to explore the seminal work of Dorothy Garrod and how the Ain Sakhri statuette portrays a self-awareness of sexuality at the dawn of human kind.

SOURCES

We accessed all available secondary source readings on Dorothy Garrod, her work, the Natufian cultures, and the Ain Sakhri stone. We also accessed the digital archives of the Pitts River Museum (Oxford), which contains the Dorothy Garrod Photographic Archive, the Mathurin collection at the Musée des Antiquités Nationales (St Germain-en-Laye, France), the British Museum (London), and digital.humanities.ox.ac.uk.

RESULTS

The Professor

Dorothy Anne Elizabeth Garrod (1892-1968) was the fourth child and only daughter of Sir Archibald and Lady Laura Garrod (Figure 2). Her father was the then Regius Professor of Medicine at Oxford following the death of Osler. Her paternal grandfather, Sir Alfred Baring Garrod (1819-1907) was known for his research work on arthritis and was Physician Extraordinary to Queen Victoria.(7) There is evidence Dorothy was exposed to archeology and anthropology at an early age, spending part of her youth with her father stationed

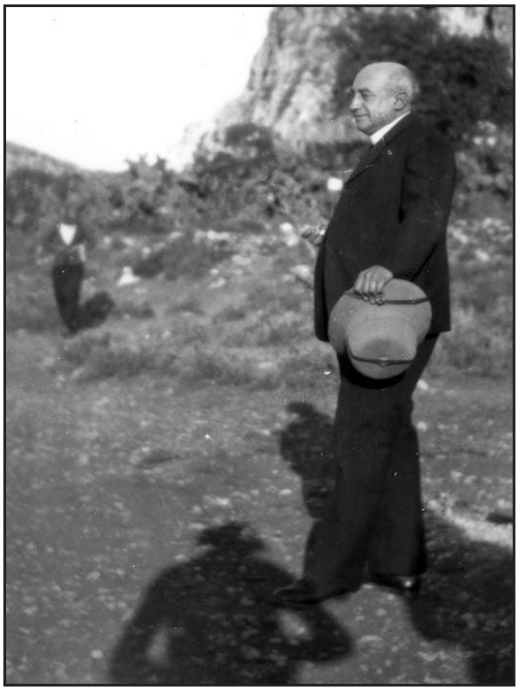

Figure 1. (Left) Dorothy Garrod (1892-1968), born into a household of scholars, became one of the great early 20th century paleo-archeologists, becoming the first female Professor at Cambridge in 1952. Her discovery of the Natufian people rewrote the age of sophisticated human cultures.(Public Domain) (Right) Abbé Henri Breuil (1877-1961), Garrod's mentor, who discovered the Ain Sakhri statute and in correctly identified the artwork as Natufian in origin (Photo by Garrod, 1931, Pitts River Museum, University of Oxford).

Figure 2. "Picknic near Nablus"(Israel). Archibald Edward Garrod (left) ad Laura Elizabeth Garrod (right) photographed by DAE Garrod, 1928. (Pitts River Museum, University of Oxford)

on Malta during World War I (the war which claimed all three of her older brothers). She worked with famed anthropologist Sir Themistocles Zammit (1864-1935) and entered Newnham College to study history and classics in 1913 since there was no current degree in archeology at that time. She then volunteered with the Ministry of Munitions in the War effort. When her father was appointed Regius Professor at Oxford, Dorothy promptly registered for the university diploma course in anthropology with Robert Ranulph Marett (1866-1943). She became proficient in early human technologies, such as in flint-work in Lower Paleolithic and Middle Paleolithic societies. She worked with the great paleo-archeologist Abbé Henri Breuil (1877-1961) and was introduced to Pierre Teilhard de Chardin (1881-1955) and converted to Roman Catholicism.(8) She wrote her first book, *The Upper Paleolithic Age in Britain,* in 1926.(9) Garrod draws our attention, however, for her discovery and identification of the Natufian culture (c.15,000 BCE- 11,500 BCE), first suspected in the Shukbah and el-Wad caves and terraces, her finds placed the Natufian peoples in the 500,000 year archeological arc of humanity transitioning from nomadic hunter-gatherers to the agrarian societies of the early Iron Age. (10-14).

In 1928, Garrod began to investigate several caves in Palestine, including the Shukbah cave where she identified Mousterian and sterile deposits containing Mesolithic industry that she named 'Natufian'. "Field conditions were harsh," wrote the Garrod scholar PJ Smith in 2000. "The crew endured uncomfortable, primitive living conditions, terrible heat, sticky humidity, limited and contaminated water, faulty equipment, dust, hot 'Khamseen' winds, violent electrical storms, torrential rains and exposure to serious disease." (4) Garrod carefully logged and photographed assemblages of stone tools included sickle blades for harvesting, heretofore unknown, lunates (hunting tools) and perforators for drilling holes, as well as mortars and pestles for food preparation. She next turned her attention to her first discovery, the Zarzi cave, and then became interested in the Mount Carmel area of cliffs where her colleague Charles Lambert had asked her to excavate three caves that led to her finding the Natufian deposits. It was there that her mentor, Abbé Henri Breuil, discovered a small calcite statue, known as the 'Ain Sakhri' figurine, that dated roughly to 9,000 BCE and identified by Breuil to be from Garrod's Natufian culture (Figure 4).(6)

Figure 3. The Ain Sakhri statue (Left and Middle) Two views of a Natufian calcite stone showing entwined sexual figures, thought to be the first known depiction of human sexualtiy, c 9000 BCE. (British Museum, London) **(Right)** Drawing illustrating possible body postures of the two figures modeled in the Ain Sakhri statue. (Drawing by the Australian anthropologist, Herbert Basedow (1881-1933), 1927, as cited in Boyd and Cook.(6))

Garrod was the first pre-historian, and the first woman, to be elected to a professorship (Disney Professor of Archaeology) at Cambridge University, a post which she held from 1939 until 1952. "Garrod was a modest, shy person and appears to have been uncomfortable with the attention her election elicited," wrote PJ Smith (4). Her appointment was ground-breaking but Cambridge appeared to be unprepared. Woman were not included in strategic meetings of college governance or even to socialize in the dining hall with other, male professors. (4) Garrod was also ground-breaking in her modern social views. Unlike many British and western peers, she viewed with great value the knowledge and experiences of local denizens around her digs. Her Mount Carmel work, for example, was composed, almost entirely, of Arabian women; she made it a point to include an important colleague, Francis R Petre, who was openly gay (Figure 4). Garrod was a prolific, and gifted, photographer and used the medium to document her many archeological sites, and the men and women she engaged in that work. Dorothy Garrod died in 1968, in Cambridge, bequeathing her library to Newnham College. It seemed that her private and unpublished papers had not survived. A widely believed myth arose that they had been destroyed, perhaps burnt even by Professor Garrod herself (15). In 1986, her original black and white negatives were donated to the Pitt Rivers Museum by her prehistorian colleague and executor Suzanne Cassou de Saint Mathurin. It was in 1996, however, that PJ Smith discovered Garrod's original handwritten field notes, notebooks, site plans, and section drawings from excavations that had been unknowingly kept at the Musée des Antiquités Nationales in suburban Paris. In 2019, the Dorothy Garrod building was dedicated at her alma mater, Newnham College, where a previously unknown recording of her voice was played nearly 50 years after her death.(16) Garrod's work raised awareness of the origins of humankind while breaking many of the boundaries of modern society. As said by Professor Mina Weinstein (University of Haifa), Garrod was among the first who showed that "Europe was not the center of the world."(17)

The Ain Sakhri Lovers

The Ain Sakhri figurine is currently archived in the British Museum, entitled "the Ain Sakhri lovers", purchased via Sotheby's from the estate of the French diplomat and prehistorian Rene V Neuville (1899-1952) in 1958 (object # 1958,1007.1). At more than 10,000 years of age, the statuette is remarkably well preserved. Its discoverers conjectured that it had "never been above ground, where it would have faded and worn away; on the contrary it bore ash marks, evidence of an existing undisturbed level, but not of clay as it would have been

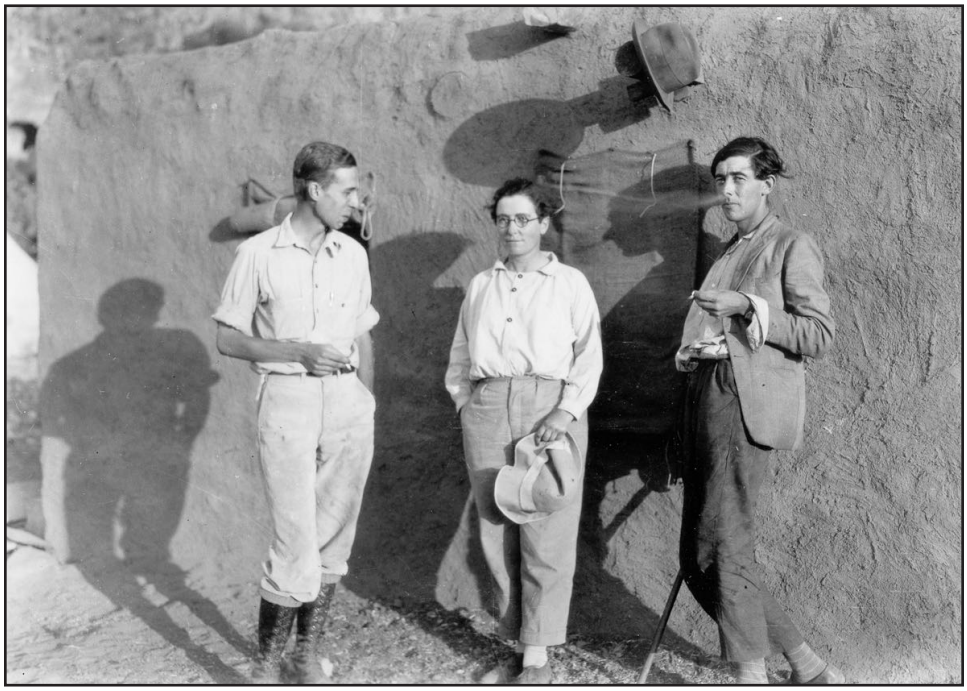

Figure 4. DAEG at Wady el Mughara with (left to right) the British anthropologist Theodore McCown, Garrod, and Francis Turville-Petre (1901-1942), discoverer of the *Homo heidelbergensis* fossil in 1926. (Pitts River Museum, University of Oxford)

the case if in a cave."(6) The sculpture measures 102 mm in height, 63 mm wide, with a depth of 39 mm and weighs 343 grams. The piece fits comfortably in the palm. It was sculptured to show a couple in coitus as well as being a phallic illustration when viewed from above or *en face*. The artist utilized a pointed, probable stone chisel to remove pieces and make the delicate, copulating figures. "The surviving natural surface on the cobble is bruised with chattermarks indicating that it came from the bed of a stream where it had bumped together with other stones. The sculptor utilised (sic) the natural heart-shaped outline of the stone to pick out the outline of a couple making love face to face in a sitting position. This was done using a 'picking' technique using a stone chisel with the stone or antler hammer to reduce the calcite surface by percussion so that the outlines of the figures appear in low relief. When first made the picked line would appear lighter than (the) natural surface of the cobble enhancing the visual impact of the sculpture."(18)

The two entwined figures are locked in an intimate coital scene, presumably a female and a male, arms and legs wrapped around one another in a sitting position. Although no facial features are shown, the lips are presumably touching and the arms of one figure bend up at the elbows embracing the other figure with the wrists touching just below its shoulders. The buttocks of the embraced figure are above the feet of the other and the knees are raised suggesting genital contact. The Natufian were one of the first cultures to begin herding sheep and goats, suggesting that this figure could represent an interest in fertility. Furthermore, Hebert Basedow (1881-1933) and Rene Neuville (1889-1952) hypothesized that the figure is similar to the sexual acts depicted in an ancient Australian Aboriginal seated copulation position in 1927.(6)

Ultimately, Garrod and her mentors illustrated the global significance of the Natufian culture and their unique depictions of sex and fertility. "(The Ain Sakhri) is the oldest known sculpture of people making love," wrote its curator. "It is easy to recognize the timeless thrill and comfort of human intimacy." (18) No faces are discernible to depict this as a heterosexual couple so its symbolic applicability to all human relationships has a particular modern day relevance. The figurine, in fact, has been part of the "Desire, Love, Identity:

exploring LGBTQ histories" exhibitions that toured England throughout 2018-2019 as well as the BBC's programming on the "History of the World in 100 objects". As the British museum curator observed, "(the Ain Sakhri lovers have) always been popular with visitors and acquired a new modern symbolism during the period of lockdown against Corona Virus in 2020, when it epitomized the simple but essential need for the reassurance of a hug that had to be avoided at that time."(18)

CONCLUSIONS:

In 1928, Dorothy Garrod provided compelling evidence to the early field of paleoanthropology of a new era of humanity existing between 12,000-9000 BCE that she named Natufian. She would go on to document numerous aspects of this prehistoric culture, transitioning from a primary hunter-gatherer nomadic society to the agrarian, domesticated societies of the early Iron Age. Garrod's work made it possible to identify the Natufian origin of the Ain Sakhri figurine. Social anthropologists hypothesize that sexuality may be best understood through its social and political setting and that such modern concepts may be applicable to pre-historic, paleolithic cultures as well.(19) The Ain Sakhri figurine may be one of the few surviving artefacts of the Natufian people but demonstrates that the human awareness of the social power of sexuality existed more than 10,000 years ago.(20). Garrod retired in 1952 and her colleagues presented her with this fitting scroll: "To Dorothy Annie Elizabeth Garrod ... indefatigable explorer of antiquity, who for thirteen years professed the science of archaeology in Cambridge with such great learning, such great splendour, such great friendliness and humanity..." The scroll ended with the epistle by Horace '*caelum non animum mutant, qui trans [mare] currunt*'- 'those who hasten across the sea, change their horizon, not their soul.'"(4)

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How a Rock Band, a Recording Company, and a Nobel Laureate Developed Computed Tomography

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Introduction: Computed Tomography (CT) is an indispensable element of medical care used throughout the world, and first developed for clinical use by Hounsfield in 1971. The largest source of monetary support for Hounsfield's work was from his employer, Electrical Musical Industries, Ltd. (EMI) and, in turn, the most lucrative source of income for EMI through the 1960's was their recording contract with the English rock band, The Beatles. The purported link between The Beatles' productive oeuvre with EMI and Hounsfield's discovery of CT has not been well established. We endeavored to elucidate the technological and creative talents that linked Hounsfield with EMI and The Beatles and which ultimately led to one of the greatest medical innovations of the 20th century.

Sources and Methods: We used GoogleScholar, PubMed, and primary sources to research the life of Godfrey Hounsfield, the history of Electric and Musical Industries, Ltd (EMI), and The Beatles in reference to the development of CT. We used the EMI Archives Trust (London), and the archives of the Institute of Electrical and Electronics Engineers (IEEE) UK and Ireland (London). We obtained unpublished photographs courtesy of private collections.

Results: EMI translated its electronic prowess during WWII into the recorded music business, purchasing Capitol Records in 1955. EMI would sign The Beatles in 1963 and EMI profits rose 80% that first year. Sir Godfrey Hounsfield began a successful scientific career with EMI in 1951. With financial support from EMI's research division, Hounsfield began developing what would become the first CT-scanner in 1967. By directing x-ray beams through the body at 1 degree angles, with a detector rotating in tandem on the other side, he could measure the x-ray attenuation of different tissues inside the body. These values were then analyzed via a mathematical algorithm to produce a 2-dimensional image of a slice of the body. Hounsfield worked with James Ambrose, a radiologist, to conduct the first clinical CT-scan at Atkinson Morley Hospital in 1971 in a patient with a brain tumor. EMI entered the medical equipment business thereafter and heavily marketed the CT-scanner using the financial resources EMI derived from its record sales. By 1976, EMI could not produce enough CT-scanners to fill demand and ultimately would cede the medical imaging business to competitors, and devote itself to the music industry. In 1979, Hounsfield, and Allen Cormack, a South African physicist who independently theorized the basis of CT imaging, would win the Nobel Prize.

Conclusions: 'Let it be' known that it was only 'yesterday' when a recording company, a rock band, and a radar scientist revolutionized medical imaging with the development of computed tomography.

Keywords: Computed Tomography, Godfrey Hounsfield, EMI, The Beatles

Prior to radiography, a physician's primary tool for diagnosis was the physical exam, which was quickly discovered to be not as discriminating as one would hope. Some early case series showed that up to 25% of patients presenting with pain due to a right-sided ureteral stone underwent surgery for appendicitis or pelvic disease before the correct diagnosis was made. (1) In 1901, Howard Atwood Kelly, one of the 'big four' physicians at Johns Hopkins, developed the technique of the wax-tipped catheter which was cystoscopically placed up the ureter to diagnose ureteral and renal calculi based on scratches observed on the wax of the catheter. (2) Röntgen's discovery of x-rays in 1895 would usher in the era of radiography. In 1906, Voelker and Von Lichtenberg would describe retrograde pyelography with collargol, a colloidial silver compound. Osborne in 1923 described excretory urography. After experimentation with many contrast media, many of which were toxic, Moses Swick discovered Uroselectan, an iodinated compound, which allowed the safe

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performance of intravenous pyelography. (3)

The sinking of the Titanic in 1912 indirectly led to the development of SONAR (SOund Navigation And Ranging). (4) Both SONAR and RADAR (RAdio Detection And Ranging) and their military applications formed the basis for the development of medical ultrasonography. The story behind the development of Magnetic Resonance Imaging (MRI) began with Tesla's discovery of a rotating magnetic field in 1882 and is filled with multiple Nobel Prize winners describing and characterizing the NMR phenomenon. However MRI technology was not applied to medicine until the 1970s. (5)

The development of computed tomography (CT) ushered in a new era in medical radiology. CT imaging was invented by Godfrey Hounsfield, an innovative scientist with EMI. EMI had been founded in the 1930s to pursue the most innovative technologies in the sciences and the arts and their work led both to the development of RADAR and television equipment as well as to a large canon of western music. EMI's investment in The Beatles, a British quartet (1960-1969), whose near total oeuvre was recorded at EMI's Abbey Road studios (London), proved to be a major financial boom and further cemented EMI's role in ground-breaking efforts (Figure 1). We wished to elucidate the relationship between Hounsfield's discovery and his development of the CT scan while at EMI and determine to what extent EMI's connection with The Beatles contributed to that effort.

SOURCES

We reviewed the medical literature regarding the life of Godfrey Hounsfield, the history of Electric and Musical Industries, Ltd (EMI), and The Beatles as they relate to the development of CT. We used primary source materials from EMI Archives Trust (London), the Institute of Electrical and Electronics Engineers (IEEE) UK and Ireland (London), and the Nobel Prize speeches and laureate lectures at www.nobelprize.org. EMI stock prices were obtained from the New York Times financial stock prices listings as found through the NYT 'Times Machine' at timesmachine.nytimes.com.

RESULTS

In My Life

Godfrey Newbold Hounsfield was born on August 28, 1919 in Newark, England and was the youngest of five children. His father was an engineer in the steel industry, who after World War I, bought a small farm and became a farmer (Figure 2). (6,7) At an early age young Hounsfield became interested in all things mechanical on the farm. He was educated at the Magnus Grammar School in Newark (now Magnus Church of England School) and though he did well in math and science, Hounsfield never excelled at school and his father thought his poor performance was due to "intellectual retardation." His early life on the farm allowed him the freedom to invent and investigate—from launching homemade gliders off haystacks to launching water-propelled tar barrels when he fondly recalled that "I almost blew myself up during (these) exciting experiments…it may now be a trick of the memory but I am sure that on one occasion I managed to get one to an altitude of 1000 feet!" He would write "this was the time of my first attempts at experimentation, which might never have been made had I lived in a city. In the village there are few distractions… and I was free to follow the trail of any interesting idea that came my way." (6,8-9)

He enrolled in City and Guilds College in London in 1939 but with the outbreak of World War II, Hounsfield

Figure 1. (Left) The front door for EMI's Abbey Road Studio, St. John's Wood, London. **(Right)** The famous 'zebra crossing' outside Abbey Road Studio, looking due north, and featured on the cover of The Beatles' 1970 "Abbey Road" album. (Credit: Claudio Caridi /Alamy Stock Photo; Martin Norris Travel Photography /Alamy Stock Photo)

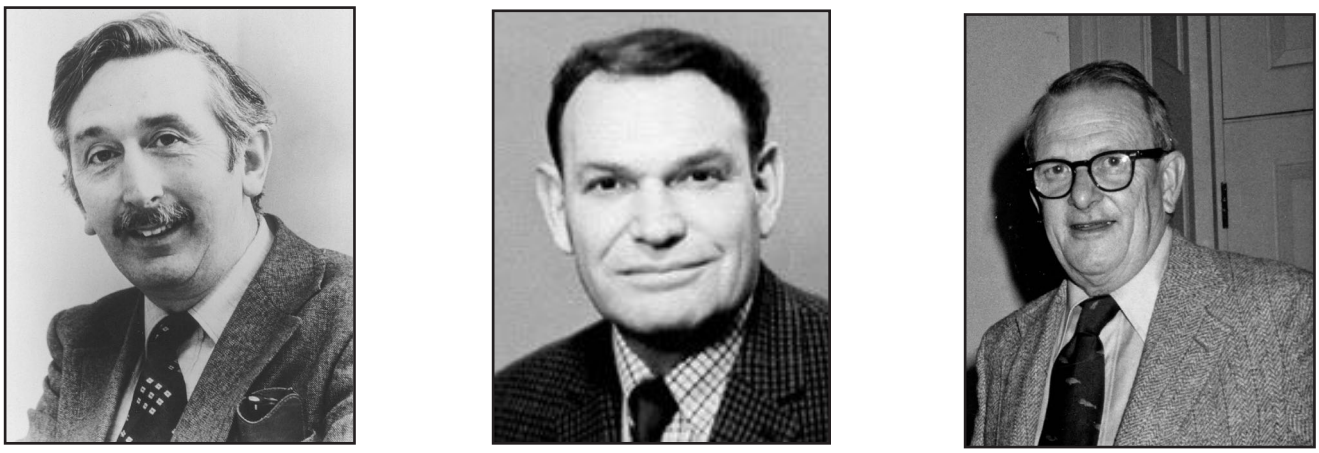

Figure 2. Pioneers in the Development of CT Imaging. **(Left)** Godfrey Hounsfield (1919-2004), the EMI engineer who invented the CT with **(Middle)** James Ambrose (1923-2006), a radiologist, conducted the world's first CT imaging in 1971; **(Right)** Allan Cormack (1924-1998), physicist, theorized the calculations that made CT imaging possible. Hounsfield and Cormack were co-winners of the 1979 Nobel Prize (All Photos, Public Domain)

enlisted in the Royal Air Force and attended the Air Force Cranwell Radar School and worked as a radar mechanic instructor at the Royal College of Science in South Kensington. (6,7) His work impressed Air Vice-Marshall Cassidy who helped him earn a grant to attend the Faraday House Electrical Engineering College in London, from which he graduated in 1951 with a degree in electrical and mechanical engineering. (6,7)

Yesterday

The company known as Electric and Musical Industries, Ltd (EMI) began in 1897 as the Gramophone company, focused on recorded music. With World War I and then the Great Depression, the company stumbled with record sales falling by more than 80%. (10,11) In 1931, Gramophone and one of its chief rivals, Columbia, merged to form EMI, Ltd. During the time following World War II, EMI emerged with significant experience in defense related electronics, developing the technology behind radar and thus helping Britain and its allies during the war. Hounsfield joined EMI as an engineer working on radar and guided weapons in 1951. He would climb the ranks, and in 1958 lead the team that designed the first all-transistor computer (EMIDEC 1100) and would eventually become chief of medical research. However, because of EMI's lack of experience in the market, it failed to leverage its innovation into economic success. (11) Fortunately for EMI, around that time, the recorded music industry began to become more profitable. In 1955, EMI acquired Capitol Records in the United States, the home of such artists as Frank Sinatra, and would sign a recording contract with The Beatles in 1962, a quartet of musicians from Liverpool. The group, under the management of a Brian Epstein, agreed to the terms of 1 farthing per double sided disc (i.e., a 'single' record) worth today about 3 cents/record.(10,11)

You (Don't) See Me

Medical imaging during Hounsfield's time was primarily reliant on the x-ray. Wilhelm Conrad Röntgen, a German mechanical engineer and physicist, produced and detected x-rays in 1895 and won the first Nobel Prize in Physics in 1901. Thus by Hounsfield's time, x-rays were the primary mode of medical imaging and had gained widespread acceptance. Hounsfield recognized the limitations of x-ray in visualizing soft tissues and came up with the idea for computed axial tomography during one of his traditional country walks, as he pondered using a computer to calculate x-ray absorption patterns of biologic tissues.

"One of the suggestions I put forward was connected with automatic pattern recognition… which was eventually to become the EMI-Scanner and the technique of computed tomography," Hounsfield wrote. (8,9) "As might be expected, the programme (sic) involved many frustrations… and some amusing incidents, not least the experiences of travelling across London by public transport carrying bullock's brains for use in evaluation of an experimental scanning rig in the Laboratories."

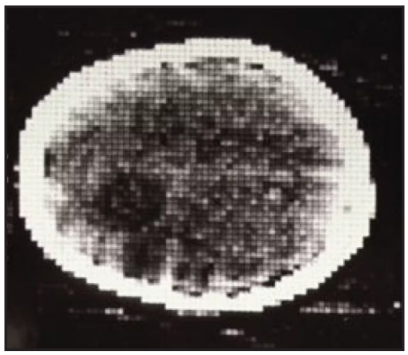

Figure 3. (Left) Atkinson Morley Hospital, November 1992, site of the world's first installed CT scan. (Photo courtesy of Harriet Richardson, University of Edinburgh, 2023). The hospital closed in 2003 and is set to become a retirement community. **(Right)** The first CT image of the human brain showing pathology, a right sided tumor, performed on October 1, 1971 at Atkinson Morley's Hospital by Sir Godfrey Hounsfield and Dr James Ambrose (Public Domain)

With a Little Help From My Friends

As Hounsfield worked on developing computed tomography, he realized he needed to collaborate with a physician, preferably a radiologist, for his invention to gain acceptance and credibility. This was one of his keys to success. He was rejected by many radiologists until he met Dr. James Ambrose (Figure 2). James Abraham Edward Ambrose (1923-2006) was born in Pretoria, South Africa. He served in the Royal Airforce and flew Spitfires in the Middle East and southern France. In 1945 he completed his studies at Cape Town University before going to England to study radiology at Middlesex Hospital in 1952. In 1959 he was appointed senior registrar at Atkinson Morley's Hospital in Wimbledon and in three years was a consultant (Figure 2). The hospital was one of the largest centers for neurosurgery in the London area and Ambrose specialized in providing images of soft tissue of the brain (Figure 3). Ambrose was recognized in the profession as an authority in the diagnosis of neurological diseases. Ambrose, to his credit, was perceptive enough not to dismiss Hounsfield's proposal and immediately recognized the potential of Hounsfield's vision. (22)

Money, That's What I (Need)

In order to build and test his scanner, Hounsfield needed a lot of help. The initial seed funding came from EMI, but he also had to solicit the UK Department of Health

Figure 4. One of the world's first clinically used CT machines, installed in Atkinson Morley Hospital, Wimbledon, England, 1971. (Public Domain)

Figure 5. The Beatles, February 9, 1964, with Ed Sullivan (1901-1974), the US TV impressario. The Beatles were an English quartet whose EMI record sales from 1962-1969 allowed EMI to support Hounsfield's research that led to the development of the CT scan Pictured are (Left to Right): Messrs: Sir Richard Starkey (1940-), George Harrison, (1943-2001), Ed Sullivan, John Lennon (1940-1980), and Sir J Paul McCartney (1942-)(Public Domain)

and Social Security for an additional £2,500. (10) He also needed Ambrose's help to work on the clinical aspects of testing the scanner. He would need even more funding when he realized his radiation source was too weak as his initial scan times took 9 days! Another £12,000 later, using x-rays, the scan times were down to a mere 9 hours.

The initial scans were focused on the head. They tried scanning formalin-fixed pathology specimens but these did not result in good resolution and delineation of tissue structure. Freshly killed bovine brains had the problem of the ventricles being filled with blood, resulting from the animals initially being shocked before slaughter. Thus, Ambrose came up with the idea to have the cows killed under kosher regulations, providing the first clear visualization of the anatomic structure of the brain. (6)

The first bovine scans were a printout of numbers, where each "pixel" was the numeric tissue density coefficients that would later bear Hounsfield's name. The single digit Hounsfield units consisted of the fluid in the ventricles. By converting the numeric values for the Hounsfield units to grayscale (from -1000 HU which is black to 3000 HU which is white; air is -1000 HU, bone is +1000) the first CT-scan images were developed.

I'm Looking Through You

In 1971, the first human patient, a woman with a suspected tumor, was scanned using EMI's Mark I scanner at Atkinson Morley's Hospital. The equipment used a translate-rotate gantry with an 80 x 80 matrix yielding a spatial resolution of 0.5cm. Reconstruction

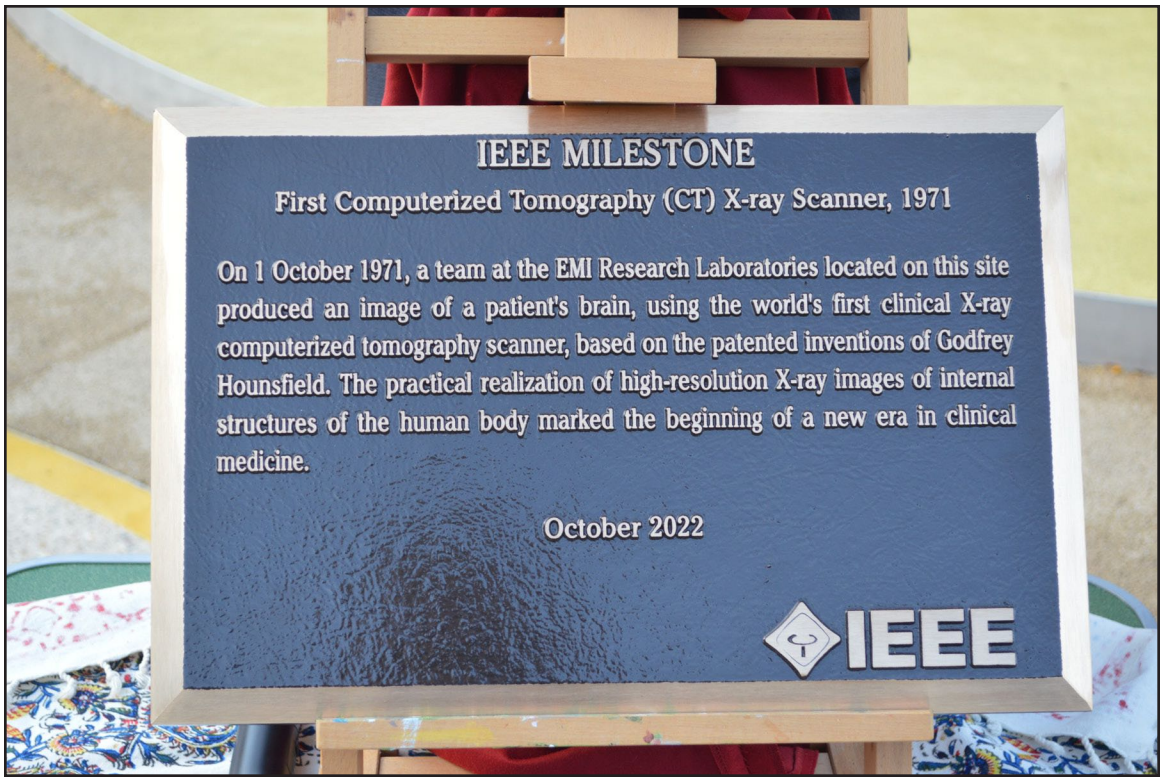

Figure 6. Memorial plaque acknowledging the critical role of the Beatles' record company EMI in the development of the CT scan: "*On October 1, 1971, a team, at the EMI Research Laboratories on this site produced an image of a patient's brain, using the world's first clinical X-ray computerized tomography scanner, based on the patented inventions of Godfrey Hounsefield. The practical realization of high-resolution X-ray images of internal structures of the human body marked the beginning of a new era in clinical medicine.*" (Courtesy Nick Wainwright, IEEE, London, 2022)

took all night but produced a recognizable image of a brain tumor (Figures 3 and 4). The first EMI production model required 4 minutes per slice and 7 minutes per reconstruction. The first description of a CT scan in the literature was published by Hounsfield in the British Journal of Medicine in 1973. (12-14)

Ambrose would be the first to describe the neuroanatomy visualized via computed tomography. It was also his idea to use contrast to further add diagnostic value to the scans. In April 1972, Ambrose demonstrated the technology in a lecture at the Radiological Society of North America. (8) We owe James Ambrose much in regards to the clinical application of CT, unfortunately his contributions are barely recognized today. (12,15)

All Together Now

In order to understand how EMI was able to fund medical research, we have to discuss EMI's most significant signing—The Beatles. A few years after Hounsfield joined EMI, a 16-year-old John Lennon and 14-year-old Paul McCartney, both of Liverpool England, formed a band called the Quarrymen. The following year, Paul's friend George Harrison joined the band. The name of the band underwent a few iterations prior to becoming The Beatles in 1960 (Figure 5). After being rejected by Decca Records (because Decca felt that guitar music was "on the way out"), they signed with EMI's Parlophone label in 1962, with their first recording at EMI's Abbey Road Studios in London. The first single was "Love Me Do". (11) They went through multiple drummers until August, 1962 when they settled on Richard Starkey, who later became known as Ringo Starr. It was during the development phase of the initial CT scanner that 'Beatlemania' hit. In The Beatles' first year with the company, EMI's profits rose 80%. (16) In February, 1964, The Beatles began their first tour of the United States with three performances on the Ed Sullivan Show. Their first appearance on February 9th, was seen by a reported 73 million viewers. By April, 1964, The Beatles' EMI records occupied the top 5 positions of the Billboard Hot 100, a feat which has not been yet repeated. The Beatles' prolific output, mostly penned by Messrs. McCartney and Lennon, was an unheralded

financial boon for EMI, allowing them to sign other 'British Invasion' artists such as the Rolling Stones, the Hollies, and Pink Floyd and channel much needed resources into the medical research division, Central Research Laboratories (CRL). The price of EMI common stock price on the New York Stock Exchange (NYSE) doubled from 1964-1968 (data not shown). The Beatles continued to be musically active until 1969 and EMI's last recording with them was in April, 1970. (17)

Here Comes the Sun

Allan Macleod Cormack (1924-1998) was a physics professor at Tufts University and in 1955 while on sabbatical, visiting his alma mater the University of Cape Town, was asked to supervise the use of radioactive isotopes at a local hospital (Figure 2). He realized how imprecise planning for radiotherapy was but saw the problem as a mathematical one. He thus developed the mathematical basis used to determine the distribution of attenuation coefficients of different tissues in the body. Hounsfield and Cormack had never met and were unaware of each other's work. (18)

In 1979, both Hounsfield and Cormack were awarded the Nobel Prize for Physiology or Medicine for the development of the CT scanner, the "greatest advance in radiologic medicine since the discovery of the X-ray." (15) The Nobel assembly cited Cormack for doing the mathematical analyses that laid the groundwork for the computerized technique and Hounsfield as the "central figure" in its practical development. (19) Cormack published his analyses of the mathematical problem in 1963 and 1964 and Hounsfield applied for a CT scanner patent in 1968. (18) During Cormack's Nobel Banquet speech on December 10, 1979, he stated "There is irony in this award, since neither Hounsfield nor I is a physician. In fact, it is not much of an exaggeration to say that what Hounsfield and I know about medicine and physiology could be written on a small prescription form!" (20)

Revolution

Similar to The Beatles' 'British Invasion', EMI's scanner would revolutionize medical imaging and 'invade' the United States. In the summer of 1972, EMI launched Hounsfield and Ambrose on a successful lecture tour of the United Kingdom and the United States, speaking to radiologists and other physicians. In 1973 the first three CT scanners were installed in the United States at the Mayo Clinic in Rochester, Minnesota, the Massachusetts General Hospital in Boston, Massachusetts, and the Presbyterian-St. Luke's Hospital in Chicago, Illinois. (7) Just four years later, there would be over 1000 scanners in the U.S. In 1973 and 1974, EMI enjoyed a monopoly on the new technology, translating it into sizable profits. Unfortunately, EMI could not capitalize on its 'first mover' advantage. Corporate expansion strained its financial resources and GE, a leader in conventional X-ray equipment, dominated the market by developing a third-generation scanner using a new fan-beam technology, leading to significantly faster scan times. (21) Shortly thereafter, Philips and Siemens would soon enter the market as EMI had difficulty keeping up with the advancing industry and EMI's stock pricing reflected its changed financial picture.

Here, There, and Everywhere

Hounsfield was lauded in hospitals and countries on both sides of the Atlantic and would go on to win numerous awards and prizes. He was awarded honorary degrees from at least 10 colleges and universities, was elected to the Royal Society in 1975 and he would be knighted, becoming Sir Godfrey, in 1981. His name is immortalized in the 'Hounsfield scale', a quantitative measure of radiodensity used in evaluating CT-scans.

He gave his Nobel lecture, complete with overhead slides and archived on film, on December 8th, 1979 at the Karolinska Institute in Stockholm. Hounsfield's advice to aspiring Nobel winners was "not to worry too much if you don't pass your 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." Hounsfield would die at the age of 84; he never married, saying that remaining a bachelor had allowed him to devote most of his life to science.

The End

The development of the CT scanner and Hounsfield's story personifies many elements of game-changing innovation. Many invent; few persevere, and the time and work Hounsfield spent overcoming unheard of obstacles in order to develop new technology cannot be quantified or fully appreciated. Hounsfield was a consummate collaborator and credited many for furthering his work. His work with Ambrose was the single most important factor in his success and acceptance by the medical community. Hounsfield enjoyed the challenges of theory but also appreciated the practical aspects of innovation including his obtaining a patent in 1968 at least 3 years before the technology demonstrated any clinical value. Importantly, none of Hounsfield's work would have been possible without the creative environment and financial support of EMI which, in turn, was greatly due to Beatles' record sales (Figures 6).(10)(23) Hounsfield and Ambrose revolutionized how the world could view the internal

structure of the human body. It is difficult to imagine modern music without the influence of The Beatles. It is equally difficult to imagine modern medicine without the CT scan. Without the support of EMI and its ground-breaking work, it may have been impossible for either The Beatles or CT scans to have come into existence.

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The Plague Doctor, the Pandemic Doctor, and Surgical Protective Clothing

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Introduction: Infectious diseases have tormented humans for thousands of years, and severe outbreaks have led to the devastation of entire communities. Even before globalization, parasites and pathogens traveled along trade routes with their human hosts. The protective clothing worn by physicians during epidemics serves as a powerful historical record chronicling accepted theories of disease transmission and treatments. The materials and designs of modern-day protective equipment reflect the contributions of surgeons to the ways doctors protected themselves and their patients during epidemics.

Sources and Methods: Historical texts and journal articles were reviewed regarding the history, epidemiology, and pathophysiology of epidemics of plague, influenza, and coronavirus.

Results: The Justinian Plague of the 540s CE was the first pandemic to be fully documented and began the long history of plagues through the Black Death of the Middle Ages. Believing that the etiology was foul-smelling bad air (miasma), doctors protected themselves by wearing dramatic head-to-toe coverings. Heavy boots, pants, long coats, gloves, and brimmed hats were made of leather sealed with animal fat. Most important was the infamous face mask with glass eye coverings and a long beak filled with aromatics intended to purify disease-causing vapors. An appreciation of droplet theory in the 19th century made beaked masks obsolete, replacing them with cloth face masks. Surgeons continued to pioneer the development of gloves and gowns, initially to protect themselves and later to protect their patients. Their outfits were worn by healthcare workers during the epidemics of the 20th century. Similar to the plague doctors, present-day physicians treating patients suffering from COVID-19 don themselves in head-to-toe protective outwear, although heavy leather and beaked-masks have long since been replaced by disposable fabrics and the N95 respirator.

Conclusions: The evolution of physicians' protective clothing from the iconic beaked mask of the 17th century plague doctor to the hazmat-esque suits of the COVID-19 pandemic doctor reflects the substantial advancements in the detection, treatment, and containment of communicable diseases. Much of this is due to the dedicated efforts of surgeons to better safeguard their patients as well as protect themselves against diseases contained in bodily fluids.

Keywords: plague doctor; pandemic doctor; personal protective equipment

Infectious diseases have tormented humans for thousands of years, and severe outbreaks have led to the devastation of entire communities. Even before globalization, parasites and pathogens traveled along trade routes with their human hosts. The Justinian Plague of the 540s CE was the first pandemic to be well documented and began the long history of the Black Death of the Middle Ages.(1) The protective clothing worn by physicians during epidemics serves as a powerful historical record chronicling accepted theories of disease transmission and treatments. The materials and designs of modern-day protective equipment—masks, gloves, gowns, caps, and eyewear—reflect the contributions of surgeons to the ways doctors have protected themselves and their patients during epidemics. Our objective was to analyze the history of the surgical protective wear and how it evolved into our modern concepts of the operating room standard of care.

SOURCES Historical texts, journal articles, and media were reviewed regarding the history, epidemiology, and pathophysiology of epidemics since the first century of the common era. We also investigated the progressive development of surgical protective clothing with a focus on masks, gloves, gowns, caps, and eyewear.

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RESULTS

Masks

Face coverings as a method of protecting respiratory health go back at least 2,000 years. Some of the earliest descriptions came from the Roman savant and author, Pliny the Elder (23–79 CE), who was said to have used animal bladders as masks to prevent inhalation of toxic dust while crushing minerals used for decorations.(2) Several centuries later, Leonardo da Vinci (1452-1519) also recommended covering the mouth and nose with wet cloth as protection from toxins.(2) Perhaps the first documented use by physicians can be traced back to the 17th century. Erroneously believing that the etiology of the plague was foul-smelling bad air or miasma emanating from the earth, plague doctors protected themselves with the infamous beaked masks filled with aromatics intended to purify disease-causing vapors (Figure 1).(3) While ineffective at preventing transmission of flea-borne plague, these filtering bird masks may be considered precursors to the duck-billed N95 respirator.

The 19th century brought about an era of great advancements in respiratory protective coverings, driven by the need for occupational protection for firefighters, miners, and military personnel as well as discoveries in the pathogenesis of disease transmission. In 1849, American inventor Lewis Haslett patented the forerunner of the gas mask and in 1877, George Nealy developed one of the first filter type masks for firefighters, the Nealy Smoke Mask.(4) Around that time, the evolution of scientists' understanding of disease transmission prompted the appearance of masks in the operating room. Surgeons were desperately searching for ways to decrease rates of surgical site infection as the mortality rate after surgery was unbearably high. In 1867, the British surgeon Joseph Lister hypothesized that wound infections were caused by the microscopic germs described by Louis Pasteur.(5) Bacteriologist Carl Flügge demonstrated that bacteria could be cultured from respiratory droplets and, after learning of this work, surgeon Johann Mikulicz began wearing a face mask at the University of Breslau in 1897.(6) Mikulicz's face mask was "a piece of gauze tied by two strings to the cap, and sweeping across the face so as to cover the nose and mouth and beard".(Figure 2)(7,8) That same year, French surgeon Paul Berger began wearing a mask in the operating room in Paris.(6,7)

Not long after, the surgical masks became more widely used in an effort to prevent the spread of disease, largely as a result of two infectious outbreaks. In 1910, the young physician Dr. Wu Lien-teh famously pleaded for mask-wearing by the public to curb the spread of the plague that devastated Manchuria; he promoted a version of the surgical mask (Figure 3).(9,10) Eight years later, in 1918, facemasks were required in some cities during the so-called Spanish Flu epidemic.(11) The 20th century also advanced the evolution of masks as a more sophisticated filtration device (rather than just droplet protection), which was further advanced due to occupational safety concerns and the world wars. (12) In 1920, MSA Safety Company manufactured the Gibbs breathing apparatus, and gas masks were refined during WWII as a protection against chemical warfare. (13) The U.S. based company 3M is credited with finally combining the surgical masks with respirator devices for use in medicine. This was largely influenced by the creative genius of Sara Little Turnbull, one of America's earliest industrial designers. She was hired as a design consultant by 3M and began experimenting with a

Figure 1. A. Engraving of the Plague Doctor, Paul Fürst, c. 1656 (Wikimedia Commons, Public Domain); B. Urologic surgeon wearing typical attire (courtesy, author AS); C. Health care worker in COVID-19 pandemic (courtesy, author (AS); D: Urology operating room attire during the COVID-19 pandemic (courtesy, author AS)

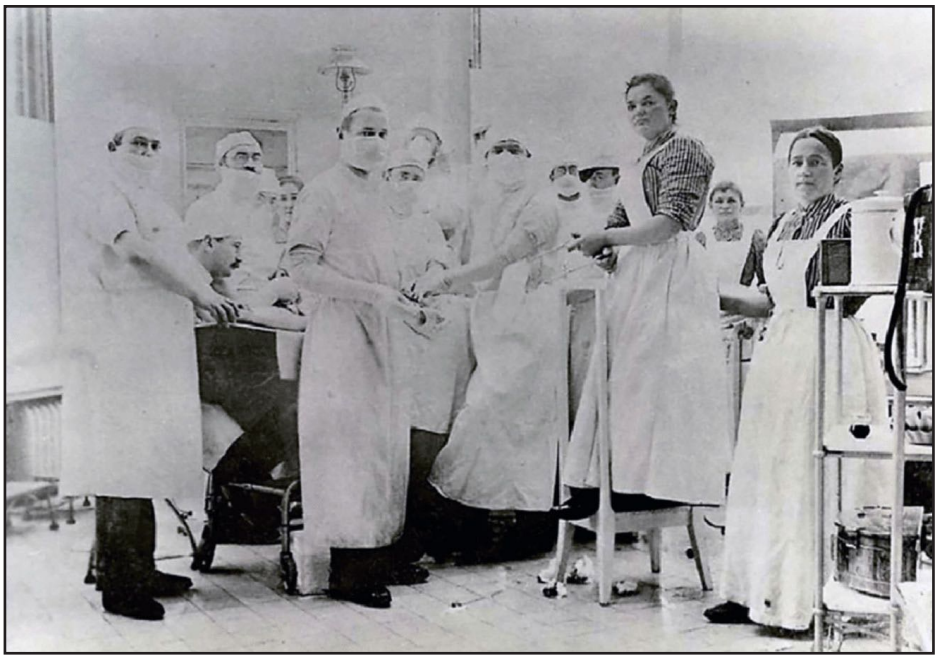

Figure 2. Johannes von Mikulicz wearing mask, gloves, and cap in the operating theatre in 1899. (Public Domain, ref. 8)

new non-woven material developed by 3M. In the late 1950s, she presented many ideas for using the material, including a molded cup bra and a medical mask. In 1961, 3M released its Bubble surgical mask that closely resembled her molded bra cup design (Figure 4).(14) The company released its first single-use N95 dust respirator in 1972, which eventually became modified and approved for preventing disease transmission.(15) Tuberculosis outbreaks in the 1990s, SARS in 2003, H1N1 in 2009, and the ongoing COVID-19 pandemic expanded the use of surgical masks and N95s by the public and health care workers.

Gloves

In modern operating rooms, it seems unfathomable that surgeons might operate with their bare hands, but this was the practice for millennia. Some of the earliest documented uses of gloves by physicians were by the 17th century plague doctors. Royal French physician Charles De'Lorme described the plague doctor uniform in 1619, which included heavy leather gloves as protection from the mysterious illness(Figure 1).(7) Early rudimentary surgical gloves were created to facilitate procedures or protect the operator from infection or caustic agents used to clean instruments, rather than for their role in antiseptic technique. In 1758, obstetrician Johann Julius Walbaum described a partial glove that mostly covered the fingers, made from sheep cecum that wouldn't cling to the vaginal wall during delivery.(16) Many years later, in 1834, the physician Robert F. Cooke sent a letter and a solution of India rubber to a professor of surgery at the College of Physicians and Surgeons at Columbia University stating, "this, if I mistake not, will become a useful material in the surgeon's hand…by lubricating the hands with it you have an insoluble pair of India rubber gloves—perfectly impenetrable to the most malignant virus."(17) Later that decade, improved methods of processing rubber paved the way for its eventual use as surgical gloves.(18) In the 1840s, Dr. Ignaz Semmelweis (Hungary) was ridiculed for his publication suggesting that handwashing by physicians could prevent puerperal fever, and it wasn't until many years later that handwashing and glove wearing would be routine for preventing infection.(19) Much of this shift was due to Joseph Lister's appreciation of antiseptic technique. He recommended carbolic washes for hands and instruments.5 When Thomas Forster (an employee of India-Rubber Works in Surrey) received a patent for the "manufacture of gloves for surgical operations" in 1878, it followed soon after that surgical teams began wearing rubber gloves to protect their hands while cleaning instruments.(20)

Already in use by this time, the most famous and well-known story of the introduction of rubber gloves into the operating room is that of William S. Halsted (Johns Hopkins), who in 1889, commissioned the Goodyear Rubber Company to produce rubber gloves for his scrub nurse, Caroline Hampton.(20) She was suffering from severe contact dermatitis that would've

Figure 3. (Left) Drs Wu Lien-teh and F. Eberson performing plague inhalation experiments in the open air in Mukden, 1916 (Visual Representations of the Third Plague Pandemic Photographic Database, University of Cambridge, https://www.repository.cam.ac.uk/handle/1810/281919); **(Right)** Anti-plague masks, 1911 Manchurian Plague. (10)

prevented her from continuing her work in the operating room—they married the following year.(18,20) Surgical glove use was further popularized when Halsted's chief resident, Joseph Bloodgood, noted that wearing gloves also prevented post-operative infection (Figure 5).(20) The technique of donning gloves for surgery was described in the early 1900s textbooks, and by 1940 gloves were commonly worn in the operating room.(21,22)

In 1965, the Ansell Rubber Company developed the first disposable medical gloves, sterilized with gamma irradiation.(23) The concept of universal precautions in the 1980s with the HIV epidemic increased the use of disposable latex gloves outside of the operating room. However, latex gloves, which are derived from plant-based rubber, can cause severe allergic reactions and are not entirely impenetrable to toxic substances. In the mid-1990s, nitrile gloves were created from synthetic rubber and have largely replaced latex gloves. During the early months of the COVID-19 pandemic, the general public was often seen donning gloves in public.

Gowns

The blue-green scrubs (so-called because they are worn in a sterile, or "scrubbed" environment) that are now commonplace in operating rooms around the globe trace back to the 20th century. Without an understanding of the importance of sterility, prior to the 19th century surgeons simply wore their street clothes in the operating theatres.(24) In the early to mid-19th century there was a switch to black frock coats, which were eventually replaced with white smocks.(24) A surgical text published in 1894 stated that "it is safer and better that all should put on a complete change of costume rather than simply don a sterilized coat and pair of trousers over

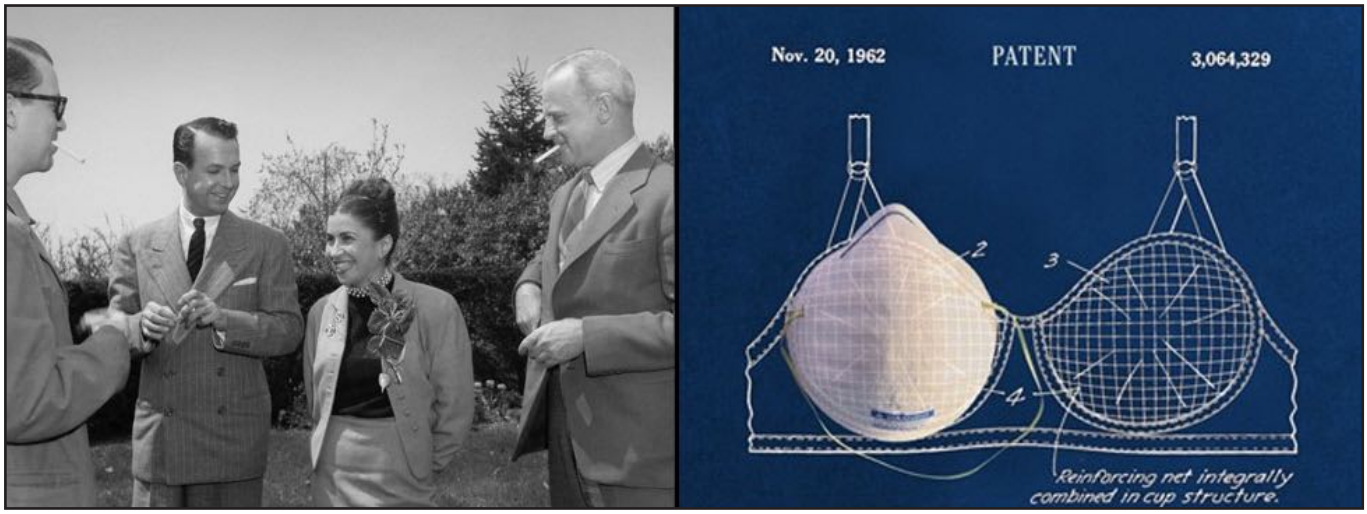

Figure 4 (Left) Sara Little Turnbull (1917-2015), second from right (© Center for Design Institute). **(Right);** 3M's bra cup patent which referenced the medical mask with a superimposed image. (© Center for Design Institute).

Figure 5. "The first surgical operation where the operator was wearing rubber gloves, 1893. Joseph C Bloodgood, third from the left. (24)

the ordinary clothing".(24, 25) By the early 20th century green scrubs came into favor, reportedly because the color would cause less eye fatigue than white under the bright lights of the operating room.(26) Notably, gowns or some type of protective outwear was worn by physicians during many epidemics, starting at least with the heavy leather coat and trousers of the 17th century plague doctor (Figure 1). Throughout the 20th and 21st century epidemics, both reusable and disposable non-surgical isolation gowns evolved in tandem with their sterile, operating room approved counterparts (Figure 1 and end plate).

Caps

Religious habits were worn in early medical facilities run by nuns, and in the 1800s, hats became a standard part of the nursing uniform.(27) By the early 1900s, surgeons were photographed wearing various types of caps in the operating room, both as uniform and antisepsis. In the 1930s, surgeons were consistently wearing them. (21) Since then, scrub caps have become a longstanding symbol of the surgical profession—so much so that proposed new regulations in 2014 that attempted to ban personalized cloth caps were met with significant resistance by the surgical community.(28) More recently, descriptions of culturally appropriate surgical head coverings have been published in the surgical literature. (29) In historical depictions and photos of epidemics, health care workers can be seen with some type of head covering dating back to the 17th century plague doctor (Figure 1).

Eyewear

Eye protection represents one of the few pieces of outerwear that was not specifically developed or advanced by surgeons. Moreover, while other aspects of surgical attire were adapted to decrease infections in patients, eye protection was added to protect the surgeon from conjunctival contamination from the patient (Figure 6). Various forms of eye protection evolved for practical use in combat, sports and recreation, as well as occupational protection.(30) Pearl diving goggles made from polished tortoise shells were described in Persia as far back as the 14th century, and a ceramic vase from 2nd or 3rd century Peru is described as a diver wearing googles while holding fish.(31) The 17th century plague doctors' facial protection included glass eye coverings; some of the first doctors to wear them. In 1880 Powell Johnson received an eye protector patent, a rudimentary eye shield composed of two layers of semi-opaque cloth meant for firefighters exposed to intense bright lights; almost forty years later, Garrett Morgan patented safety glasses.(32) Eye protection was thought to interfere with the vision of surgeons and wasn't widely adopted for some time, although it did become more common in the 1980s during the HIV epidemic. It was also worn by physicians during various epidemics to protect them from exposure to splashes and respiratory secretions. Nowadays, eye protection of some form is required in operating rooms and is especially important to urologists and others who frequently deal with bodily fluids (Figure 7).

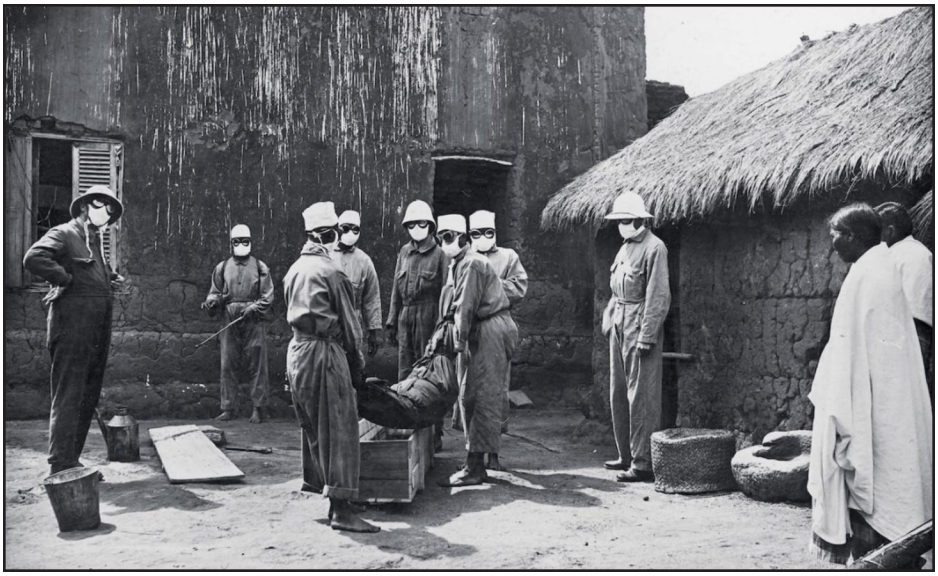

Figure 4. Team wearing eyewear and goggles puts a plague victim into a coffin in Madagascar around 1935 (National Geographic, 7/14/2020).

DISCUSSION

Much of modern-day protective clothing was initially worn by physicians who—without an understanding of disease transmission—bravely cared for those stricken with mysterious illnesses during epidemics. The need for occupational protection also drove innovation in protective clothing, especially in terms of respiratory health. The acceptance of droplet theory and the role of antisepsis in the late 1800s represents a historical milestone that was instrumental in the development of surgical attire. The gauze surgical mask has come to symbolize the way health care workers and the general public protect themselves during infectious outbreaks. Surgeons continued to pioneer the development of gloves and gowns, initially to protect themselves and later to protect their patients. Surgical attire was further adapted for health care workers during epidemics of the 20th and 21st centuries.

Similar to the plague doctors, present-day physicians treating patients suffering from COVID-19 don themselves in head-to-toe protective outerwear, although heavy leather and beaked-masks have long since been replaced by disposable fabrics and the N95 respirator.

CONCLUSION

The evolution of physicians' protective wear from the iconic beaked mask of the 17th century plague doctor to the hazmat-esque suits of the COVID-19 pandemic doctor reflects more than a century of substantial advancements in the detection, containment, and treatment of communicable diseases. Much of this is due to the dedicated efforts of surgeons to better safeguard their patients as well as themselves. The iconic plague doctor trappings of four centuries ago corresponds to almost all of the available personal protective equipment: respirator mask, gloves, gown, goggles, cap, and face shield.

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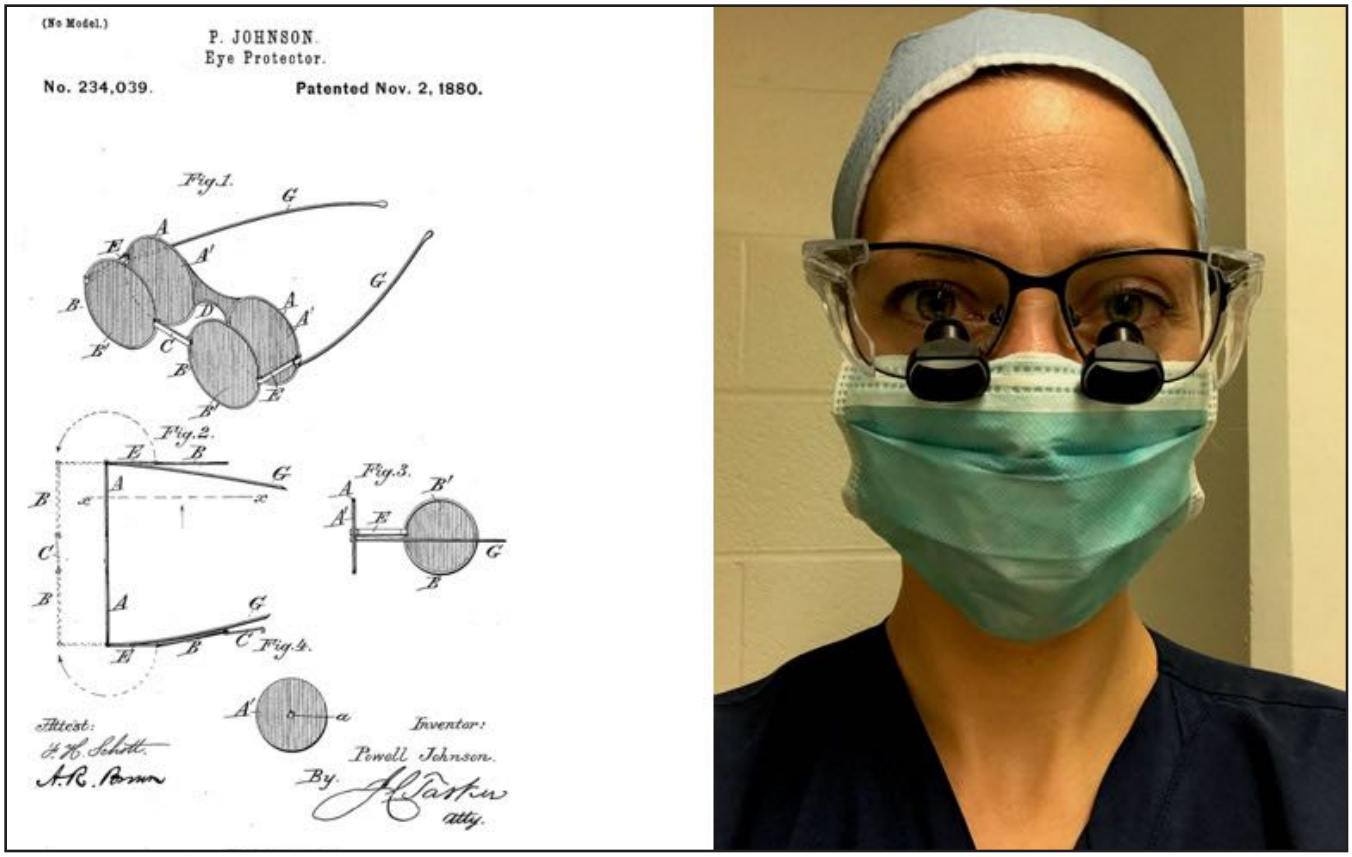

Figure 5. Surgical Eye protection. **(Left)** Powell Johnson's "Eye Protector" patent (United States Patent Office, 1880). **(Right):** Example of modern surgical eyewear (courtesy, author (AS)).

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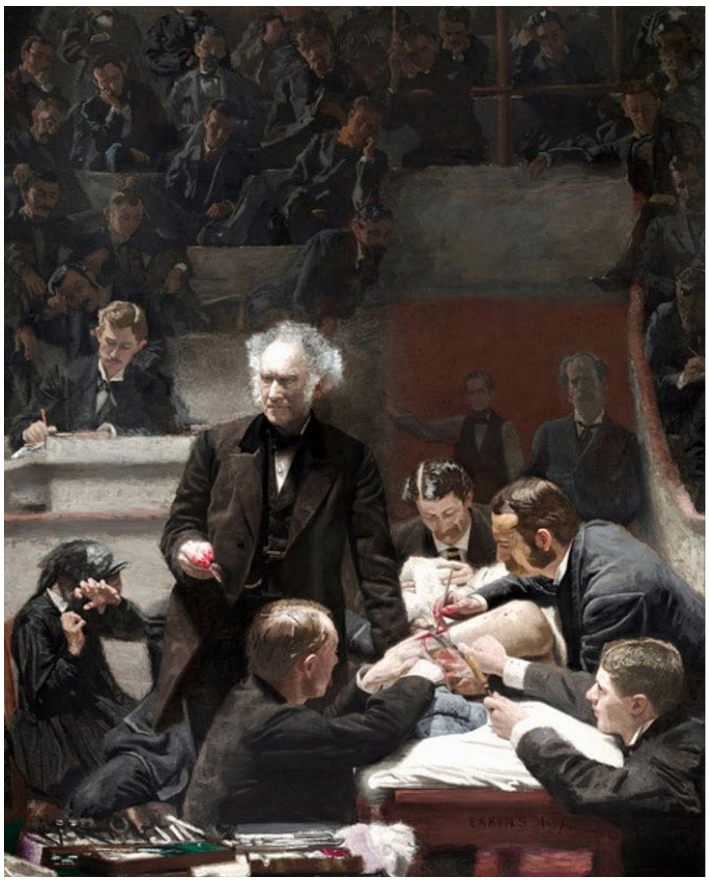

Endplate. The evolution of PPE in the operating theater. (Left) "The Gross Clinic", Thomas Eakins (1875). Samuel Gross wears a frock coat during surgery, as do all of his attendants.(24) (**Top right).** "The Agnew Clinic", Thomas Eakins, (1889). All members of the surgical team now wear clean white gowns yet none wear gloves.(24) **(Bottom right).** Urologic surgeons in the operating room, 2021 (courtesy of the author).

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Think Inside the Box: Wilhelm Reich's Theories on Orgasm and the Orgone

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Introduction: As the originator of the term "sexual revolution", Wilhelm Reich – an Austrian physician, psychoanalyst, political activist and author – was a significant, albeit controversial, contributor to his field. Throughout his career he extensively studied the human orgasm and developed the theory of "orgone energy" as a driving force present in animate and inanimate beings. While Reich's theories are now largely seen as pseudoscientific, his views on sex and orgasmic energy have had an enduring impact in popular culture and society.

Sources and Methods: We analyzed primary material including journal entries and personal accounts obtained from the Wilhelm Reich Museum (Rangeley, Maine). We reviewed published secondary sources on Reich, news articles, and biographies obtained through on-line public resources as cited.

Results: Following a tumultuous childhood, Reich attended medical school in Vienna and started his early career under the tutelage of Sigmund Freud. Freud's influence was instrumental in the development of Reich's theories on character analysis and orgastic potency and his ideas were some of the first linking mental and sexual health. Reich also notably combined his interests in politics and sexual health and created "Sex-Pol" clinics, clinics that provided both sexual and Marxist education along with contraceptives, to the working class. Prior to WWII, Reich fled Nazi Germany to the United States, where he studied the relationship between sexual health and cosmic energy, a novel concept he termed "orgone". To harness this energy, Reich invented "orgone accumulators'' which, among other claims, were thought to improve physical and mental health. Ultimately, Reich's notoriety garnered him attention from the American government, which led to the censorship of his works and ideas and eventual downfall and imprisonment.

Conclusions: Although Reich's theories were largely discredited later in his life, he was a pioneer in advocating for a deeper curiosity of sexual health and its personal and societal consequences, which continue to impact society today.

Keywords: Wilhelm Reich, orgone, sexuality, psychology

Theories on the nature and biology of human sexuality are replete with works by Freud, Foucault, and Erickson who are arguably the foremost 20th century authors on the subject. The name of Wilhelm Reich may be less well known yet at one time would eventually have devoted followers on both sides of the Atlantic and revolutionize mainstream thinking about sex. Wilhelm Reich (1897-1957) was a Viennese-born psychiatrist, psychoanalyst, political activist, inventor, and prolific author whose works ranged from such broad subjects as the origins of life to the biology of the female orgasm (Figure 1). (1,2) His theories on sexual health in 1920s Europe suggested that functionally productive orgasms were the basis of good individual health and that, in turn, could improve the health of society (3). Reich called for a 'sexual revolution' in Europe, and was part of the sex-reform movement in Vienna and Berlin, which was closely allied with anti-fascist political activism. (4,5) He eventually escaped Nazified Europe in 1939 for New York City and began a remarkable 10-year career advocating his theories of 'orgone' and sexual health which became enormously popular, epitomized by his invention of 'orgone energy accumulator boxes'. When Reich passed away in a Pennsylvania state prison in 1957, however, his theories had been debunked, his name disgraced, his works confiscated or destroyed, and was painted by the FDA as a charlatan and a fraud. (6) During life, however, Reich was a close member of Sigmund Freud's inner circle, a correspondent of Albert Einstein, and a thinker whose practices had inspired a

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sizable following throughout American society from Norman Mailer to Saul Bellow.(7) We wished to explore further the life of this enigmatic individual, the basis of the theories that so influenced his contemporaries, and how the career of a celebrated polymath ultimately ended in a prison cell.

SOURCES An initial search on Google was performed to find relevant source material. Select writings by Reich, along with secondary sources including biographies, news articles, journal entries, personal accounts, and information from the Wilhelm Reich Museum (Rangeley, Maine) were subsequently examined in detail.

RESULTS

Early Years and Theory of the Orgasm:
Born in 1897 to an affluent family, Reich experienced a childhood marred by spousal violence, infidelity, and the untimely deaths of his parents.(8) Upon graduating from medical school in Vienna in 1922, Reich began his career working in the psychiatric clinics of Sigmund Freud. From those experiences, Reich formulated his early theories on the function of the human orgasm. Reich believed that sexual repression and impairment which he partially attributed to society's Christian morals and underpinnings, led to "neuroses" – synonymous in those times with mental illness. Failure to achieve complete orgasm, Reich argued, prevented release of libido and contributed to the development of mental illness. (9,10)

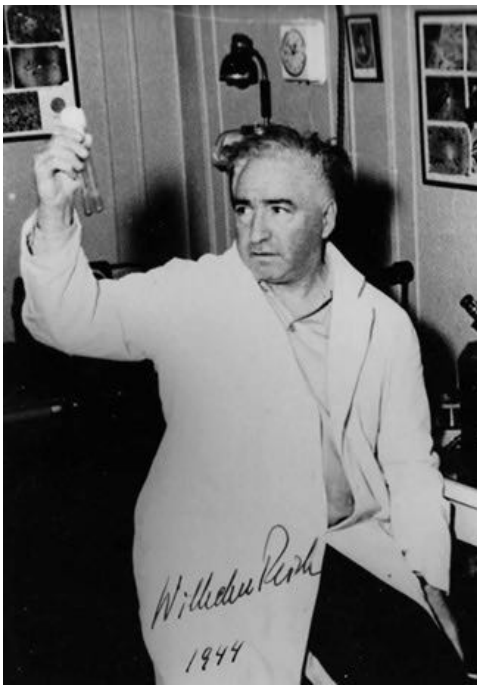

Figure 1. Wilhelm Reich (1897-1957), in his laboratory, Orgonon, Maine (Granger Academic®)

Orgastic Potency
Reich coined the term "orgastic potency" which he defined as "the ability to resolve existing sexual need-tension."(1) In doing so, he supposed that the ability to achieve a satisfactory orgasm was present in healthy individuals while an inability to climax was seen chiefly in those with neuroses (Figure 2).(1) Thus, by addressing an individual's sexual dysfunction, Reich believed that improved orgasms and sexual fulfillment would ultimately improve one's mental state.

Differences of 'Reichian' and Freudian Thought
Though Reich's early ideas were influenced by Freud, he ultimately differed from his mentor in several respects. Both believed in a biologic source of sexual energy, but Reich extended the Freudian concept of libido to include a harnessable, quantifiable source of energy which formed the basis of his orgone theory (Figure 3)(11) Furthermore, while both believed mental illness stemmed from conflict between individual sexual instinct and societal norms, Freud believed individual sexual instinct must be subsumed to societal norms while Reich argued that society itself was the main perpetrator of sexual repression and needed to be addressed.(12,13)

"Sexual Politics"
To highlight his belief in society's complicity in sexual repression, Reich put his ideas into practice by becoming the messiah of "sexual politics", or "sex-pol." In 1927, Reich opened several clinics in Vienna which offered what one author claimed was a mixture of "psychoanalysis, Marxist advice, and contraceptives" to working class patients, men, women, teenagers, and the elderly. (14) Inspired by the writings of Karl Marx, Reich later moved to Germany and joined the Communist party where he championed the idea that sexual liberation was the beginning of social and economic reform of the proletariat. Though Reich's political activism was ultimately cut short by the rise of Nazism and his subsequent immigration to the United States, Reich's idea of combining class struggle with psychoanalysis made him one of the forerunners of the modern day sexual revolution.(15)

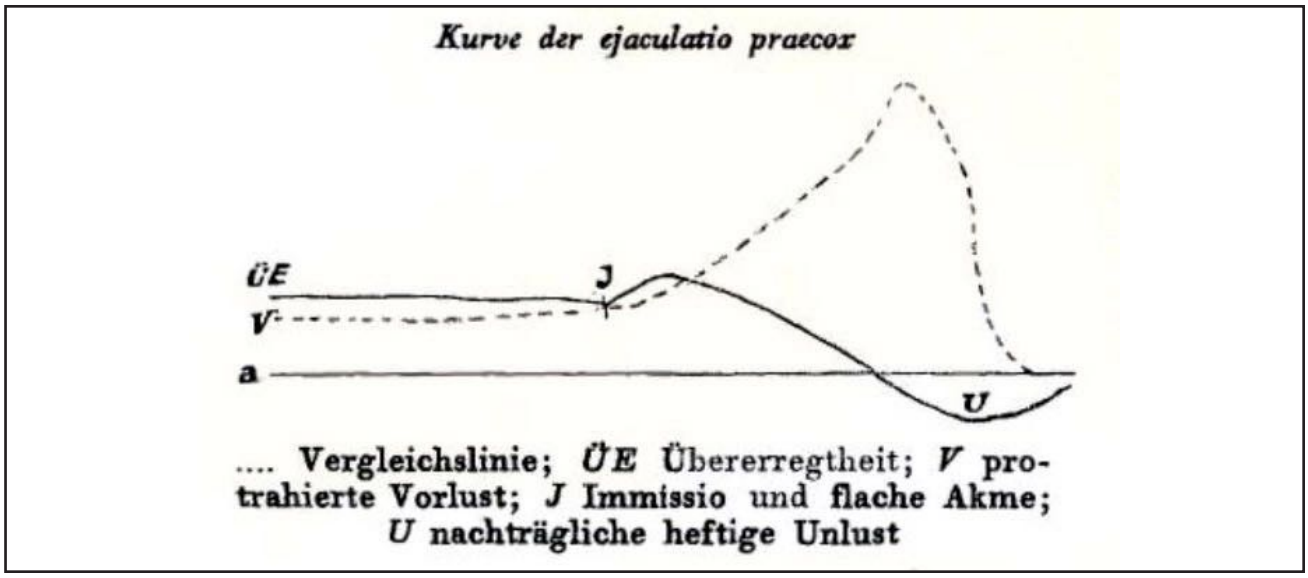

Figure 2. Reich's theory comparing sexual excitation of a healthy individual (dotted line) with that of an affected individual (solid). From *Die Funktion Des Orgasmus* by W Reich, 1927 (1), p 20. (Gr. *Kurve der ejaculatio praecox*: Curve of Premature Ejaculation; *V, Vergleichslinie*: Comparison lines; *ÜE, Übererregtheit*: overrexcitation; *V, protrahierte Vorlust*: prolonged foreplay; *J, Immisio und flache Akme:* intromission and shallow climax; *U, nachträgliche heftige Unlust*: subsequent intense disgust; a, no excitation)(Public Domain)

Harnessing the 'Orgone'

Continuing to build upon his idea of functional causes behind physical ailments, Reich spent his time in the US cultivating experiments to champion his orgone theory. He claimed that the high humidity of New York City dampened his observations.(16) In a 1940 camping trip to Maine, the brilliance of the night sky so convinced Reich of the evidence of atmospheric orgone, he dedicated all his personal energy and cash to the building of an orgone research center in the New England wilderness. In 1942, he purchased a 175-acre property of fields, forests, and hills that bordered tiny Dodge Pond, about 25 miles from the Canadian border, and which had stunning views in all directions. For $35,000, Reich had a stone complex completed and called the property "Orgonon". A "Students' Laboratory" was completed in 1945 supplemented by an "Orgone Energy Observatory" a few years later (Figure 4). (17)

It was at Orgonon that Reich developed and ran most of his projects though now largely seen as pseudoscientific. Reich built upon his hypotheses from the 1920s and postulated that orgone was a harnessable, biologico-cosmic energy present in inanimate matter as well as living things. Reich built a wood and metal box to harness this omnipresent energy field which supposedly functioned like a Faraday cage, allowing an individual to sit within and accumulate orgone (Figure 6). The device became widely popular when released to the public, especially among the countercultural 'beatniks' such as Jack Kerouac, William Burroughs, JD Salinger, and Norman Mailer. (18). Mailer himself built several for his personal use in Connecticut, insulated to also facilitate 'primal scream theory' then popularized by Arthur Janov (1924-2017). " 'They were beautifully finished', remembered Mailer's friend, the theater producer Lewis Allen, 'and there was a big one that opened like an Easter egg. He climbed inside and closed the top . . .' "(19). Woody Allen, in a nod to the accumulator, included an 'orgasmatron' in his1973 film "Sleeper" into which the film's protagonist climbs to evade the police. (20)

To many, Reich's box was seen as a celebration of the individual, in which sexual liberation became a form of political activism although the mechanics of the device itself strained credulity. "When I first came across a reference to the accumulator," wrote Christopher Turner in 2011, "I was puzzled and fascinated: why on earth would a generation seek to shed its sexual repressions by climbing into a closet?"(Figure 5)(19)

In 1941, Reich also started using orgone accumulators to treat terminally ill patients. While Reich himself never promised his patients any cure, there

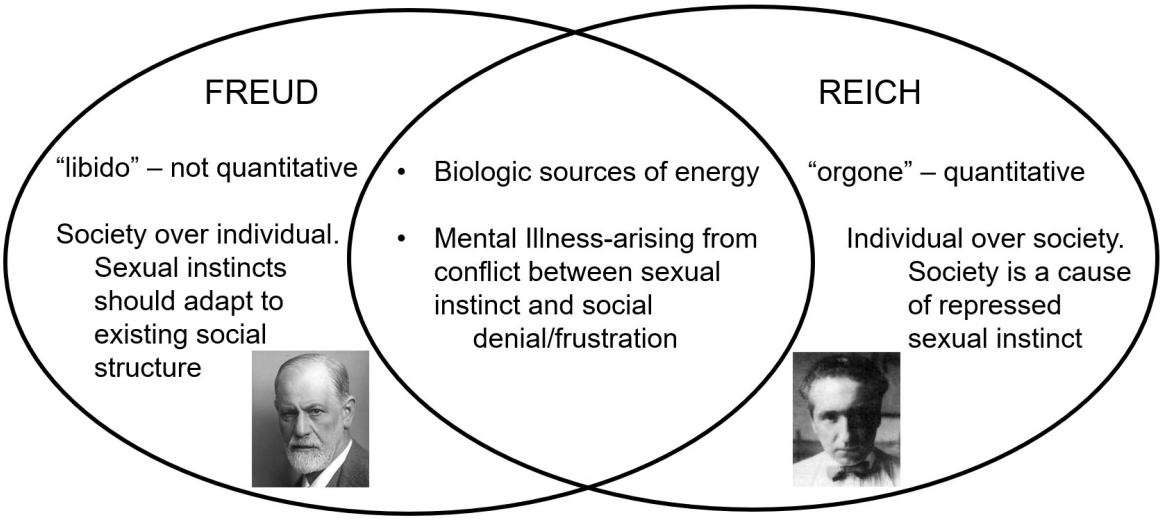

Figure 3. Freudian (left) vs Reichian (right) theories underlying sexual function, the individual, and the conflict with society. (Photos: Freud, Library of Congress, Public Use; Reich, AA Brill library, New York)

are many testimonials of patients reporting improved physical and mental wellness which they attributed to using an orgone accumulator. (18, 21) One such account was written by a Norman Shapiro, who was diagnosed with terminal lung cancer. He underwent many days of 'orgonomic therapy' at the behest of his wife, spending many hours a day inside an orgone accumulator. Shapiro managed to live long beyond his life expectancy and even reported a decreased tumor size on radiography (22).

Reich expanded his research further as his popularity increased and started the self-published International Journal of Sex-Economy and Organon Research which distributed his own works and those of collaborators, psycho-social essays, testimonials, and book reviews from 1942-1952. Reich also conducted a series of 'experiments' that evaluated cosmic sources of organon, the effect of organon on 'cloudbusting' using a special organon 'gun', and the effects of organon on bacterial growth. He also conducted the "Oranur" experiments of 1951, in which he placed radioactive radium (somehow procured from the Canadian Radium and Uranium Corporation in New York City) into modified orgone accumulators in the Student Laboratory.(23) His observations, it is said, provided evidence that orgone even had effects on the atomic nucleus. The accumulator appeared to have properties, writes Turner, that contradicted "all known principles of physics".(19) Einstein himself spent two weeks analyzing the box: all of Reich's claims were refuted.(24) Nevertheless, the popularity of the boxes continued and became a central object in the growing sexual pioneer communities of the west coast. Descriptions of the box and Reich's works were eventually reported in the lay press which caught the attention of the United States and its Food and Drug Administration (FDA).

FDA Injunction and Fall From Grace

The FDA, citing concerns about patient safety and medical commerce, reviewed and debunked Reich's work. In 1954 the FDA issued a Complaint of Injunction against Reich, believing his ideas not only to be fraudulent but also dangerous to the public. The injunction declared orgone to be nonexistent, banned Reich's works, and prevented interstate transport of his orgone accumulators. (25) When one of Reich's assistants unwittingly violated the injunction, the FDA charged Reich with contempt of court, and, following a 1956 trial, Reich and his assistant were imprisoned. The FDA burned thousands of Reich's publications in New York City in what was one of the largest federally-mandated book burnings in American history (Figure 6a).(18)

Figure 4. Former Student Research Laboratory and Observatory, now the Wilhelm Reich Museum (Wilhelm Reich Museum, Rangeley, Maine)

Aftermath

On March 8, 1957, a few days before he was taken to a jail, Reich executed his Last Will and Testament before several devotees. In the documents, he established the Wilhelm Reich "Infant Trust" because, he felt, the future of the world was invested in safeguarding the "unarmored life" of infants whom he called "The Children of the Future." (26) He first entered the federal prison in Danbury CT before moving onto Lewisburg Federal Penitentiary in Pennsylvania. There, Reich died on November 3rd 1957 of a myocardial infarction just 8 months into his 2 year prison sentence. His body was brought back to his adopted home state of Maine and put to rest in a dedicated tomb on the Orgonon property. The stone observatory itself had become abandoned but reopened by the Wilhelm Reich estate trustees in 1960. In 1999, the building was listed on the National Registry of Historic Places. The Wilhelm Reich cottage, Tamarack, where Reich lived with his family, has waterfront views of Dodge Pond, and is generally available for public use on AirBnB.

CONCLUSIONS: Reich died a convicted felon, accused of fraud, and his works banned by the United States. His legacy, however, lives on - in pop culture as well as among a small minority who continue to advocate for his visionary world (Figure 6b). Reich wrote of many theories about society, politics, and the role of sex in shaping the future. His writings were relevant to many who fought for reproductive rights, for patient autonomy and palliative care, and sexual health, all topics relatable to us as urologists, physicians, and humanists. Reich's work also came to symbolize the conflict between the individual and the state, from his days as an anti-fascist in 1920s Europe to 1950's America where some, including the ACLU, viewed the FDA's actions against him as heavy-handed censorship violating 1st amendment provisions. Reich was, at the very least, an innovative figure, engaged in wide ranging passions from the function of orgasms to methods to treat cancers and end drought. Wilhelm Reich may have indeed demonstrated to his followers that sometimes one may need to sit inside a box in order to think outside of one.

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Figure 5. Orgone Energy Accumulation Box showing subject sitting within and supposed rebreathing apparatus to be used when the door has been closed. A cone sized hat was also provided to some subjects to further concentrate 'orgone' levels. The FDA categorized Reich's work as "fraud of the first magnitude."(25) (Photo, public domain, Food and Drug Administration, Washington DC)

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BOOK ORDER APPEALED

Liberties Unit Asks U. S. Not to Destroy Reich's Writings

The Food and Drug Administration has been urged not to destroy books of Dr. Wilhelm Reich. The appeal was made public Wednesday by the American Civil Liberties Union. The union held destruction of the books would be censorship.

Dr. Reich, who lives in Rangeley, Me., is appealing a two-year sentence for contempt of Federal Court in Portland, Me. This grew out of failure to comply with an injunction prohibiting distribution of his so-called orgone energy accumulators or literature about them. The books were held to have been used as "labeling" for the devices, which the agency termed therapeutically worthless.

The union said some of Dr. Reich's books had already been destroyed in Rangeley.

Figure 6a. (Left) The FDA-mandated burning of Reich's books was widely reported and generated claims of censorship by the ACLU. (New York Times, 13 July, 1956) **Figure 6b**. (Right) Kurt Cobain (1967-1994) inside an original Reich orgone accumulatory box owned by Reich-devotee, the American writer William Borroughs (1914-1997)(28).

orgasm. What is his legacy?". In: Slate, June 26, 2011. Accessed May 8, 2022. https://slate.com/culture/2011/06/christopher-turner-s-adventures-in-the-orgasmatron-wilhelm-reich-proselytized-for-the-orgasm-what-is-his-legacy.html.

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« *L'économie sexuelle naquit de la tentative d'harmoniser la psychologie des profondeurs, de Freud, avec la théorie économique — et politique — de Marx.* »

W. Reich.

Figure 7. Wilhem Reich's 1930s concept of 'sexual politics'. that a "sexual economy grew out of an attempt to consolidate Freudian psychology with the economic and political theories of Marx." (From dedication page, *Sexuality and Work*, Boris F and Münzer T, F. Maspero, Paris, 1968 (gallice.bnf.fr))

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From Terror to Treatment: a History of Human Castration

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Introduction: Castration is any action, surgical or chemical, by which an individual loses use of the gonads, most commonly referring to loss of the testicles. Reference to elective castration has been, according to Diodorus, as old as the human record itself, first being practiced in pharaonic Egypt. Castration has been practiced as a means to produce eunuchs, a punitive measure in military and secular courts, and a source of trophy-taking in warfare. The role of castration in the control of advanced and metastatic prostate cancer became a well recognized standard of care in the mid-20th century earning Nobel Prizes for its pioneers. Our aim was to better understand the history of human castration and its transformation from an instrument of terror to a standard and sometimes life-saving urological treatment.

Sources and Methods: A literature review on human castration was performed through Medline, PubMed, the Gutenburg Project, and Google Scholar searching words "castration", "eunuch", "orchiectomy" and "androgen deprivation". We accessed the public archives of the British Museum (London) and digital classical libraries as cited. Reports were collected to create a timeline.

Results: First reports of human castration date back to the 21st century (BCE) in the ancient city of Lagash, Sumeria when used for the creation of court eunuchs. Castration figured prominently in most ancient cultures from myth to jurisprudence. The god Uranus was castrated by his son, Cronus (Saturn), with an adamantine sickle, throwing the severed gonads into the sea. There is at least conjectural evidence of castration on medical, criminal, and even volitional grounds from pharaonic and classical history through medieval and modern times. Primitive medical observations recognized the different phenotypes of pre-pubertal and post-pubertal eunuchs especially on the voice which may account for the popularity of some castrati in the history of choral music. Castration was a well-established procedure in the domestication of animals for millennia but it was only in 1941 that Charles Huggins and others first demonstrated the effects of bilateral orchiectomy in the control of prostate cancer. Medical castration, now with special androgen receptor inhibitors, continues to be a mainstay in the management of metastatic and hormone refractory prostate cancer.

Conclusions: Medical or surgical castration plays an important role in the modern management of advanced prostate cancer. Castration has existed in human cultures for thousands of years, although its true prevalence is unknown, accounted for in the folklore and sparse records typical of ancient times.

Keywords: castration, orchiectomy, androgen deprivation

Castration is any action, surgical or chemical, by which an individual loses use of the gonads, particularly of the testicles for males (1). Surgical castration is bilateral orchiectomy and chemical castration uses pharmaceutical drugs to deactivate the testes. Androgen deprivation therapy (ADT) is the mainstay for the treatment of advanced prostate cancer. The use of ADT and orchiectomy, or medical and surgical castration, respectively, result in loss of endocrine testicular function (2,3). Human surgical castration, however, is a practice known from at least Sumerian times from 4,000 BCE and had militaristic, punitive, and religious roles (4-6). Little is known, however, about the timeline of how castration evolved from its role in primitive jurisprudence to modern oncologic guidelines. We aimed to elucidate the history and roles of surgical castration in early human societies and draw a time line from its earliest descriptions to the seminal Nobel-prize winning work by Charles Huggins in the 1940s.

SOURCES

A literature review on human castration was performed

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through Medline, PubMed, Google Scholar searching words "castration", "eunuch", "orchiectomy", and "androgen deprivation". We accessed original and classical texts through Project Gutenberg (www.gutenberg.org), BNF Gallica (bnf.gallica.fr), and online public domain digital repositories as cited. All reports were collected and a timeline of the history of human castration was performed. Public domain images were accessed for illustrations as cited.

RESULTS

Greek Mythology

Hesiod (fl 750-650 BCE) depicted in his Theogony the origins of the universe as an allegory of intergenerational warfare. "For Uranus (Heaven) hated all the children that were born of him and Gaia (Earth). He used to hide them all away in a secret place of Earth as soon as each was born to prevent them seeing the light of day". (7) Gaia pleaded with these many children to "punish the vile outrage of (their) father." Only Chronos accepted the challenge and, waiting in ambush, castrated his father with an adamantine sickle, tossing the testicles into the sea, from the foam of which arouse Aphrodite.(Figure 1) While Hesiod's tales may not reflect contemporary practices, castration as a form of military retaliation and the generation of slaves may have been well recognized (4,8). Herodotus (c 484-425 BCE) wrote of young Hermotime who was castrated by a certain Panione, a trader in eunuchs, and who eventually dispatched the boy to a Sardinian king. Years later, having risen in court favor, Hermotime, now on a Greek mission, called upon the Panione home outside Athens: "Oh wickedest of all men" Hermotime said of his former captor. "What insult have you received, you or those of your house, or of my relatives, for having reduced me to this miserable state in which, from a man that I was, I am now neither man nor woman? " (9) Hermotime then proceeded to have Panione and his four sons castrated which was the subject of scholarly debate for the limits of vigilante jurisprudence

Mesopotamia

Several historical writers provide conflicting accounts of the supposed origin of human castration. Vossius believed that the procedure evolved from the Persian village of Spada from which is derived the Latin root

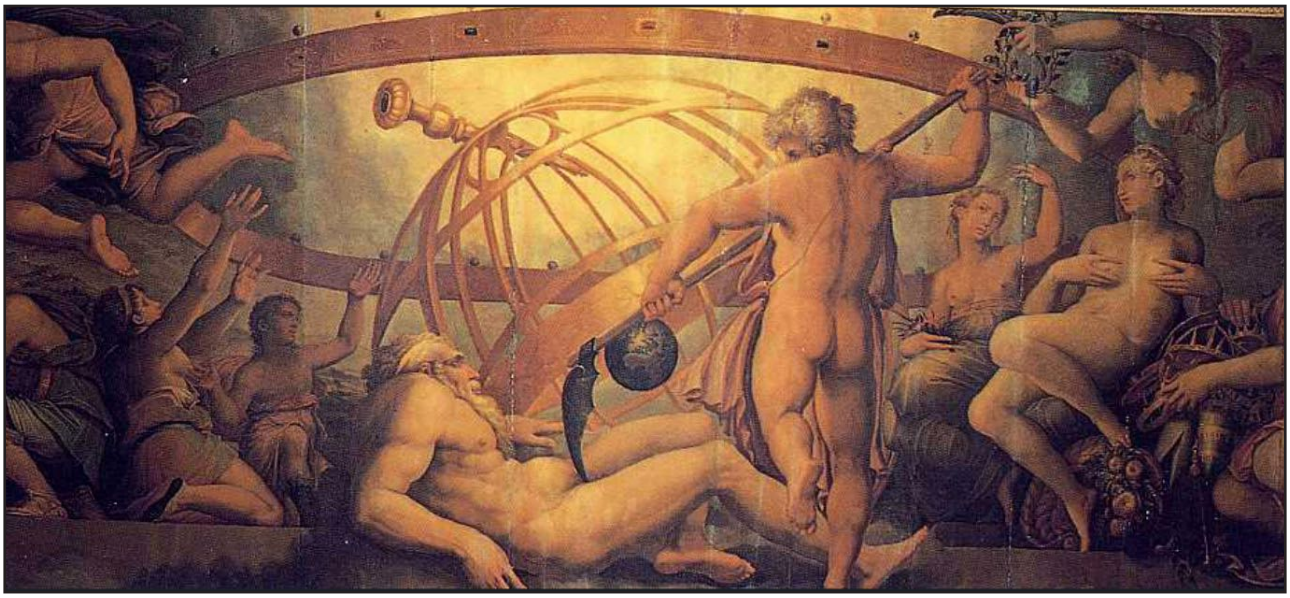


Figure 1. *Mutilasi Uranus* (Castration of Uranus) by Cronus (Saturn), at the behest of Gaia, Uranus' wife and Chronus' mother. By Giorgio Vasari (1511-1574) and Christofor Gherardi (1508-1566), from the ceiling of the *Sala degli Elementi (*Room of the Elements), 2nd floor, Palazzo Vechio, Florence, Italy (Public Domain)

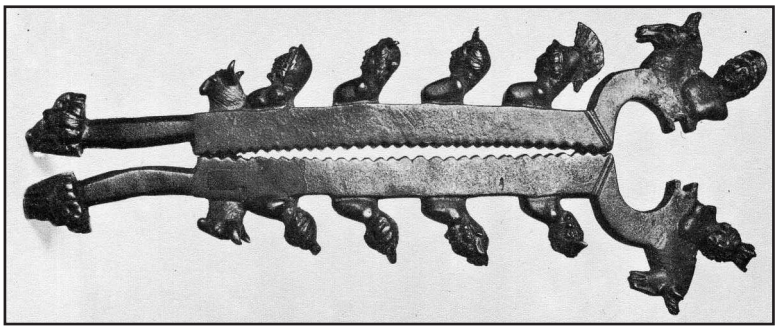


Figure 2. Roman bronze castration clamp, 3rd century AD, believed to have been used in the cult of Cybele, found in the Thames at London Bridge, London, 1840. "The outer edges of the clamp are decorated with the busts of ten divinities: Atys (?), Mars, (Tuesday), Diana (Monday), Apollo (Sunday), Saturn (Saturday). Cybele, Mercury (Wednesday), Jupiter (Thursday), Venus (Friday), Ceres." From *British Art and the Mediterranean* by Franz Saxl and Rudoph Wittkower, Oxford University Press, 1948. (Public Domain)

'spado' (10). Diodorus, a Sicilian scholar of antiquity, claims that the Assirian Queen Semiramis was known to subject her post-coital lovers to castration and thus may be the first regent in history to do so (10). Other scholars claim that eunuchs were created for use in the court in the ancient city of Lagash, near modern Telloh between the Tigris and Euphrates rivers in Southeast Iraq (4). Nebuchadnezzar (650-562 BCE), the Persian general who ravaged Jerusalem, was said to have castrated certain prisoners of war and conscripted them into his own service (11). Between 395 AD – 1453, during the Byzantine Empire, castration was considered as a punishment and due to bleeding or infection, was seen largely as a death sentence (8,12). In Arabian countries, castration was initially prohibited by Muhammad, but was eventually used to obtain a faithful group of harem guardians since at least 750 AD, underlying the etymology of the word 'eunuch' (*eunoukos*, Gk: bedroom guard).(4,5)

Pharaonic Egypt

Evidence of castration in pharaonic Egyptian civilian and court procedures is scant owing to the difficulties in interpreting hieroglyphic literature on the subject (13). Castration as a mean of war trophies was apparently undertaken by Ramses III in Medinet-Habu although the famous Merneptah Stele depicts these acts on the war dead and not on the creation of eunuchs (14). Diodoro himself found little evidence of eunuchs in pharaonic courtly life. The 18th century Egyptologist Jonkheere believed that the unique depictions of certain figures in hieroglyphic steles depicted the adipose, skeletal, and muscular changes of castration as evidence for eunuchs. Ippolito Rosellini (1800-1843) concluded that the use of a yellow-brown color of some court figures, being a combination of the red ocre used in males and yellow in females, indicated the eunuch (15). One difficulty in figuring the role of the castration in Egypt is the ambiguity of the words for eunuch sometimes translated from the Egyptian word 'saris'. Both eunuch, derived from 'bed watcher' (see above) and 'saris', an Akkadian word for 'he who is at the head', are used interchangeably in some anicent texts (16). In Old Testament Genesis, Putiphar, known in many texts as the "eunuch of Pharoah", was said to have brought Joseph to Egypt (17). The long-held belief that Putiphar was, in fact, castrated may have contributed to the legend of Putiphar's wife, Zuleikha, apparently bereft of consanguinity, to try and seduce Joseph himself. The latter, barely escaping Zuleikha's clutches, left behind his cloak, evidence which landed Joseph in pharoah's jail and become the subject of many medieval and Renaissance artists.(Figure 2)

Asia

Evidence of human castration in Asia date back to the 11th century BCE. Eunuchs were said to have served as palace gate keepers and served the emperor during the Zhou Dynasty (18). Court eunuchs held great respect, and sometimes great power. The eunuch Zhao Gao (c 258-207BCE) was said to have usurped power after the death of the First Emperor of Qin (18). One of the most important court eunuchs may be Cai Lin (cc 50–62 – 121 AD) in the Eastern Han dynasty who, as legend has it, was inspired to invent paper by the observing the nest building of paper wasps.(19)

Figure 3. "Henry Hohenstaufen torturing the young William III of Sicily, son of Tancred", circa 1410. In: *Des cas des nobles hommes et femmes* (Ms. fr. 190/2) by Giovanni Boccaccio (1313-1375). Fol. 169(r). Bibliothèque de Genève, Paris (Public Domain)

Religious Self-Gilding

There is some evidence that self-castration or 'gilding', may have played a role in some religious sects. Followers of the goddess Cibele were said to castrate themselves during rituals in which they 'gifted' the resected gonads to her.(8)(Figure 2) In the New Testament book of Matthew, Jesus was said to state of eunuchs that "there are those who are this way from their mother's womb, some who have been made eunuchs by men, and those who have made themselves eunuchs for the Kingdom of Heaven."(20) In one of the more infamous cases of Biblical literalism, a certain 2nd century Alexandrian Christian, Origen (c 185-c 253), underwent self-gilding, because, according to Ancillon, "he resolved to execute to the letter the perfection which he persuaded himself that Jesus had proposed in those words of the Gospel".(21) He was condemned by contemporaries, and self-gilding was prohibited by the General Council of Nicaea, but not before inspiring another sect, lead by a certain Valesiens, to require self-gilding as the price of admission.(22) Despite anti-castration canonical law, modern-era religious mutilation continued. The Skoptsy sect in present day Russia was led by believers, primarily a one Kondratiy Ivanovich Selivanov (d 1832), who felt that the 'purity' of men and women could only be accomplished after the removal of the sources of sexual lust: the testicles in men and the breasts in women.(23) Selivanov and his followers were subjected to multiple arrests, exhilement, and captivity, yet the Skoptsy sect lived on, even after his death, up until the 1970s.

Secular Self-Gilding

Tales of self-castration are found in medieval and Renaissance literature. The King of Syria commanded a certain Combabus, a learned scholar in his court, to accompany Queen Stratonice on a long, nearly three year journey. So fearful of being the subject of the King's suspicions and jealousies, he reasoned that he would either lose his life or his sex. "As soon as he was at home...after having sighed deeply he cut off the secret parts that we do not name and put them well embalmed in a box which he sealed; When it was time to leave (with the Queen), he gave the box to the King in the presence of a large number of people, and asked him to keep it for him until his return. He told him that

Figure 4. "Abelard and his Pupil, Heloise", by Edmund B Leighton (1852-1922), 1882. a Victoria rendering of the medieval couple in a pensive moment. Peter Abelard's castration, ordered by her vengeful uncle Fulbert, was chronicled by Abelard (1079-1142) himself, who went on to be an important scholar of the 12th century.(Public Domain)

he had put something there which he valued more than gold and silver and which was as dear to him as his life. The King put his stamp on this box & gave it to the Master of his wardrobe to keep."(24) Alanna Skuse writes of the 17th century surgeon James Yonge being called to stemp the bleeding of a 20 year old victim of self-gilding or, as Yonge described it, 'Origen Secondus'. (25) Yonge's patient claimed religious motives but the surgeon suspected a somewhat poorly thought out and violent exercise of self-repudiation perhaps in response to a recent sexual rejection.

Reprisals and Jurisprudence

There is no doubt that castration as a form of secular or military reprisal figured prominently in tales of dread and terror (Figure 3). Roman law castrating adulterers was codified hundred of years before and lived on the Gaelic laws of the 1st-5th centuries AD. "It may also be said that it was founded on that law of equity, which says that the penalty must be inflicted on that member of the body who has been the instrument, or the accomplice of the crime".(26) Castration as a form of retribution may be as equally severe and few cases exceeded the literary reach of the fable of Abelard and Heloise. Heloise was one of the most well-educated women of her time and, it was said, a great beauty. She fell in love with Abelard and the two conspired to marry (Figure 4). Heloise's Uncle Fulbert strongly disapproved and, suspecting his niece's apparent impregnation, forwent civil jurisprudence and ordered Abelard's castration during a notorious home invasion. Abelard himself recovered and wrote of the evening. "Violently incensed, they laid a plot against me, and one night while I all unsuspecting was asleep in a secret room in my lodgings, they broke in with the help of one of my servants whom they had bribed. There they had vengeance on me with a most cruel and most shameful punishment, such as astounded the whole world; for they cut off those parts of my body

Figure 5. Portrait of Farinelli, the stage name of Carlo Maria Michelangelo Nicola Broschi (1705-1782), a celebrated castrato of the 18th century and who was named chamber musician for the court of King Philip V of Spain.

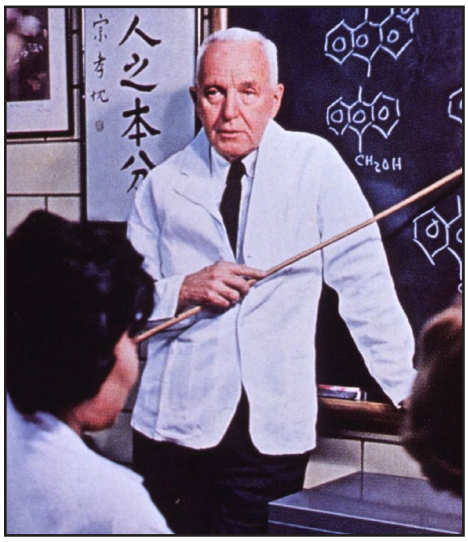
with which I had done that which was the cause of their sorrow".(27) Abelard convinced Heloise to join a nunnery and he himself a monk, becoming a prolific scholar of religious works. Abelard's attackers themselves were apprehended, castrated and blinded, reminiscent of the contemporary fate of a young William III (c 1186-c1198). The Hohenstaufen emperor Henry VI (1165-1197)) claimed the throne of Sicily, exiling the then 8 year old regent and his mother to remote Swabia. At some point, Henry VI opted to change William's worldly form, and had the now 12-year old castrated and blinded but was able to nevertheless survive a few years longer in that miserable state.(28) Even in mid-18th century England, castration was considered as a reputable, and formidable, form of corporeal punishment. Skuse writes that "In 1731, for example, it was suggested that thieves be punished by gelding rather than branding or hanging. The reasons advanced for this proposition were various: the punishment would be a deterrent; it would prevent the influence of 'lewd women'; it would eradicate criminal bloodlines; and it would produce men potentially useful as singers or caretakers for noble wives and daughters."(29)

The *Castrati*.

Not all castrations, apparently, were based on violence and reprisals. From the late 16th century, castration was carried out in Italy to preserve the unbroken male voice into adult life (30). The initial stimulus for the production of castrati came from the Sistine Chapel in Vatican. In 1737, The most famous castrato singer in history Farinelli (1705-1782) was named chamber musician by the Spanish King Philip V and 'criado familiar', or servant to the royal family (Figure 5). These singers, or castrati, underwent pre-pubertal castration, before the subject could either provide consent or demonstrate true musical ability. Still, the practice of maintaining pure or 'white' voices in adult men remained a custom in some church choirs even up until 1922 with the death of the world's last known Italian castrato Alessandro Moreschi (1858-1922), whose singing can still be heard on YouTube (31).

Therapeutic

Hippocrates once observed that "eunuchs were never bald (and)...they have a more complete brain than other men to whom Venus causes them to lose a good part



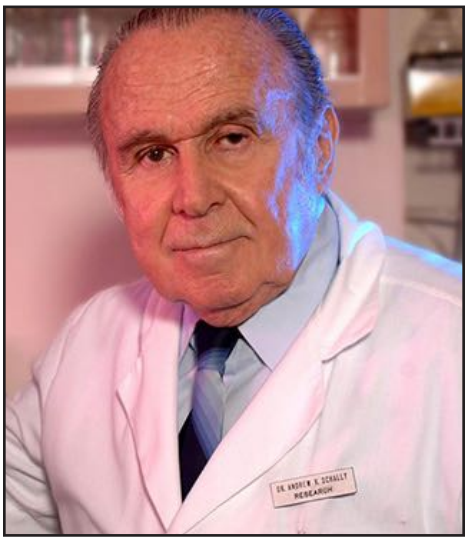


Figure 6. Nobel Prize winning pioneers of androgen-based therapy of prostate cancer. **(Left)** Charles B. Huggins who first identified the effect of medical castration on advanced prostate cancer (From Modern Medicine). **(Right)** Andrew V Schally (1926-) who discovered the hypothalamic regulation of the pituitary gland, work which led to the treatment of prostate cancer via GNRH manipulation. (VAntage Point blog, November 15, 2021. Accessed December 1, 2022. https://www.va.gov/HISTORY/Features/Dr_Schally_009.asp)

of"(32). Pliny (AD c 25- c79), it is said, thought that eunuchs also evaded gout (33). John Hunter (1728-1793), in his pivotal works of the 18th century, made the observation, however, that "the prostate gland, Cowper's glands, and the glands along the urethra, are in the (normal) male large and pulpy, secreting a considerable quantity of slimy mucus... and is only thrown out when in vigour for copulation : while in the castrated animal these are small, flabby, tough, and ligamentous, and have little secretion. From this account there appears to be an essential difference between the parts connected with generation of the (intact) male, and those which remain in one that has been castrated, more especially if that operation had been performed while the animal was young." (34)

The relationship between testicular function and prostatic enlargement was not unknown to later surgeons. In fact, J William White, of the University of Pennsylvania, in his 1893 paper to the American Surgical Association, described the successes of relieving symptoms of advanced prostatic hypertrophy after "double castration" as an alternative to suprapubic prostatectomy, which had a quoted mortality rate of 20%. (35).

Charles B Huggins of the University of Chicago addressed the somewhat conflicting obserations of White and others study castration and its effects on BPH through histologic analyses (Figure 6). He obtained prostatic sections before and 3 months after castration in 3 subjects with prostatic enlargement and urinary retention, subject #2 of whom had prostatic carcinoma and pelvic metastases. While there was some effect of castration on prostatic stroma and hyperplastic glands in patients #1-3, epithelial cells demonstrated marked atrophy and, in subject #2 with prostate cancer, "there (was) no evidence of malignancy in (the) sections."(36) Huggins hypohesized that "the prostatic epithelium, (was) at least...under control of the testes" and, building upon observations by Robinson and coworkers, Huggins embarked on a biochemical study assessing the affect of castration on serum alkaline phosphatase levels in patiens with prostate cancer and skeletal metastases. "At least with respect to serum phosphatases," Huggins wrote, "disseminated carcinoma of the prostate is inhibited by eliminating androgens, through castration or neutralization of their activity by estrogen injection."(37)

Huggins later reflected upon the early days of his observations noting that "we became certain we had something important. I was excited, nervous, happy. That night I walked home one mile and I had to sit down two or three times, my heart was pounding so. I thought: This will benefit man forever. A thousand years from now, people will be taking this treatment of mine."(38)" Huggins was nominated for the Nobel prize in 1950 and 1951 and was successfully awarded in 1966, the 2nd urologist, after Werner Forssman in 1956, to be so awarded, but the 1st award for work in the field of Urology.(39)

In 1944, treatment with diethylstilbestrol (DES) was described as the first method of reversible castration (40). Although more expensive, medical castration is currently the standard considering its hypothetical reversible effect

and the psychological trauma related to surgery (40). Medical castration, however, like its surgical analogue, also became abused by institutional powers. In 1952, the pioneering computer scientist Alan Turing accepted chemical castration with DES instead of imprisonment when convicted of homosexuality (40). In 1966, psychologist John Money infamously employed medroxyprogesterone acetate as a treatment for pedophilic urges (40-41). Medical castration by means of medroxyprogesterone acetate or cyproterone acetate is also said to be used for convicted rapist or sex offenders in some countries (41). Castration via reduced GNRH expression, now the mainstay of long-term androgen deprivation, was heralded into use by Andrew Victor Schally (Figure 6). Schally and Roger Guillemin showed in the 1970s that advanced prostate cancer patients treated with daily doses of LHRH agonists experienced a 75% decrease in serum testosterone levels and a marked reduction in cancer-associated bone pain. Schally and Guillemin shared the 1977 Nobel prize in Medicine (41-43).

CONCLUSIONS:

Castration for a variety of punitive, religious, and quasi-medical reasons has been documented since at least the 21st century BCE. While surgical castration is now an uncommon but still utilized method in the control of advanced prostate cancer, the achievement of the castrated state is now a standard of care in treatment of metastatic disease. The timeline of castration shows that the procedure has emerged over 5000 years from primordial tales of myth and brutal, primitive jurisprudence, to a potentially life-saving modality in the treatment of prostate cancer.

Timeline of Human Castration: from Terror to Treatment

- 2100 BCE. First documented castration in the Sumerian city of Lagash
- 1100 BCE Eunuchs serve as palace gate keepers, Zhou Dynasty
- 258-207 BCE Zhao Gao usurps throne after death of Emperor Qin
- 200-100 BCE Possible court role of eunuchs in Pharaonic Egypt
- 100 AD Activity of the Cybele cult
- 200 AD Self-castration of Origen; the rise of the Valesien sect
- 395-1453 AD Castration codified punishment in Byzantine law
- 750 AD Castration used to produce harem guards
- 1119 AD Castration of Abelard
- 16th century Italy: rise of the *castrati*
- 1707 Definitive historical text on eunuchs by Charles Ancillon, Paris
- 1737 *Castrato* Farinelli named court musician for Philip V of Spain
- 1750s-1970s actvity of the Russian *Skopcy* sect
- 1890s use of double castration in the management of BPH
- 1922 Death of Moreschi, last known Italian operatic castrato
- 1941 Huggins et al. induce castration to control prostate cancer
- 1952 Alan Turing undergoes medical castration with DES
- 1966 'John Money' Era: medroxyprogesterone to treat pedophilia
- 1970s Schally et al. identify hypogonadal control of pituitary LH

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Hunter H McGuire– Ignominious Legacy of a Confederate Surgeon

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Introduction: National protests in the wake of the murder of George Floyddemanded that Confederate statues be removed from public view as symbols of slavery and racism. A statue still stands in Richmond, Virginia, dedicated to a Confederate surgeon, Hunter Holmes McGuire (1835-1900). The Richmond, Virginia Veterans Administration (VA) Hospital bears his name. Dr. McGuire became a contemproary influential figure in American medicine, and served as the President of the American Medical Association; he was also a racist. A biogaphy of McGuire is hereby compiled to better understand his rise to prominence in the Confederate South.

Sources and Methods: Medical articles, commentaries and speeches authored by Dr. McGuire, bibliographies and contemporary newspaper columns.

Results: Dr. McGuire served as a surgeon in the Confederacy from 1861-1865 and in that rolewas credited for saving many lives. After the war, he became nationally and internationally known as a compassionate physician, gifted surgeon, teacher and educator. A third of his medical publications were devoted to advancing urologic care. He founded Richmond'sUniversity College of Medicine (which merged with the Medical College of Virginia in 1913) and later became president of the American Medical Association. Dr. McGuire was also a pro-slavery advocate his entire life, was a white supremacist, whose statue still sits behind the Virginia state capital building..

Conclusions: HunterMcGuire made significant contributions to American medicine, but his unrepentent racism and pro-slavery views and actions have tarnished his legacy.

Keywords: Hunter McGuire, Confederate surgeon, racism

In the wake of the murder of Geoge Floyd by a Minneapolis policeman on May 5, 2020, the nation again relived a long history of racial inequality and its historical roots in slavery. This included cries to expunge all Confederate monuments, plaques, and other tributes to supporters of the old South from public view. On September 8, 2021, the statue of Confederate general, Robert E. Lee, was removed from the Virginia State House in Richmond, where it had stood for 131 years (1). According to the Southern Poverty Law Center, one hundred sixty-nine Confederate symbols were removed in 2020 alone. Another statue to a prominent Confederate soldier still stands on Capital Square in Richmond. Unlike Lee, who killed his fellow Americans in a war to defend secession and slavery, Hunter Holmes McGuire was a trained physician who used his surgical skills to render care on and off the battlefield. Despite his influence in medicine and contributions to medical education, and ascension to the Presidency of the American Medical Association (AMA) in 1893, McGuire was apro-slavery racist. This paper illustrates the difficulties in defending the actions of historical figures who, entrapped by archaic and inhumane philosophies, made contributions to the betterment of some but not to all.

SOURCES

Primary and secondary sources include medical journal papers, pamphlets, public speeches and comments authored by Dr. Hunter McGuire, biographies (including one by his son), newspaper columns and commentary, National Museum of Civil War Medicine, the Handley Regional Library, the Winchester-Frederick County Historical Society, the Valentine Museum (Richmond), and the Hunter Holmes McGuire Collection.

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RESULTS

Hunter McGuire, the physician

Hunter Holmes McGuire was born and died in the family home in Winchester, Virginia (Figure 1). His father, Hugh Holmes McGuire, (1801-1875) was a prominent surgeon who founded Winchester Medical College (later to be razed by Union troops in 1862). Young Hunter often accompanied his father on rounds or in the hospital, and as a teenager even took some medical courses. He obtained his medical training at the Winchester Medical College graduating in 1855, then continued medical studies at the Jefferson Medical College in Philadelphia. Angry over John Brown's failed raid on Harpers Ferry in 1859, McGuire led 300 Southern medical students to Richmond where he and many others matriculated in the Medical College of Virginia. With the onset of hostilities between the North and South in 1861, McGuire enlisted as a private in the Confederate Army, but because of his medical background was quickly reassigned as a medical officer to General Thomas "Stonewall' Jackson's II Corps of the Army of Northern Virginia. McGuire became Jackson's personal physician and lifelong friend, until the General's untimely death from friendly fire during the battle of Chancellorsville in 1863.(8)

During the war, McGuire treated thousands of soldiers felled by bullets and disease. He organized the Confederate medical service, rapid transportation of the injured, standardized field hospital procedures and safe use of anesthesia, and supervised the surgical care of doctors less experienced. His own surgical skills and outcomes were second to none, and his greatest asset was his sound surgical judgment. He knew when to operate and when not to operate, when surgery was unlikely to help or make the injury worse. Such restraint was rare among Civil War surgeons. (8,9)

McGuire's most significant medical contribution during the war was an agreement that all medical personnel captured during battle be allowed to return to their respective commands to care for their wounded. This became known as the Winchester Accord.(10) For the remainder of the war, captured doctors, nurses and aides were immediately released, saving an untold number of lives. The National Museum of Civil War Medicine (Frederick, Maryland) wrote "Thanks to Dr. Hunter McGuire's idea…the safety of medical personnel drastically improved. With the safety and quick release of doctors, assistants, and nurses ensured, care of the wounded progressed. It could be argued (that) Dr. McGuire revolutionized American battlefield medicine by humanizing the battlefield and giving injured men a better chance to receive the care they needed to survive" (11). The Winchester Accord was incorporated into the First Geneva Convention, which set the rules of conduct of armed conflict for the international wars that followed. The Boston Medical Journal said in his 1900 obituary that he had "humanized" war.

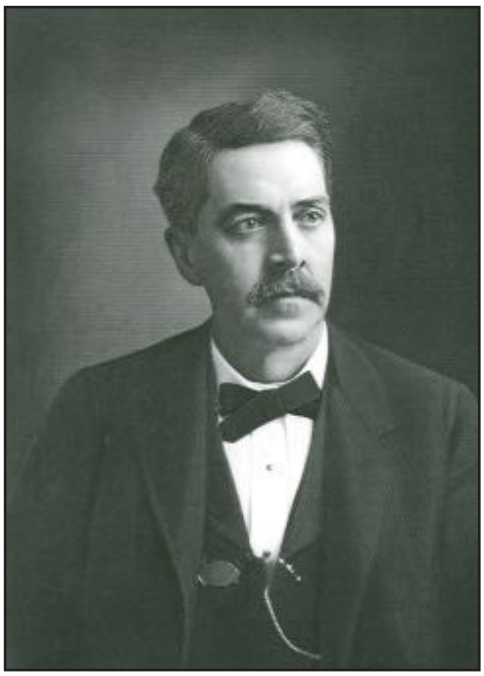

Figure 1. Hunter Holmes McGuire (1835-1900) (National Museum of Civil War Medicine)(Public Domain)

Figure 2. Dr. McGuire (far right) with a group of doctors, nurses, and nursing students at St. Luke's school of nursing, Richmond, Virgina (c.1886; note all are white. Blacks were excluded from attending nursing schools until the late 1890s) (Virginia Historical Society) (Public Domain))

McGuire was present at Lee's surrender to Grant at Appomattox and thereafter settled in Richmond building a large practice which included some reports of charity care and voluntary teaching at the Medical College of Virginia.(8) In 1883, he founded St. Luke's Hospital for the Sick, a private hospital in Richmond near the capital building. There were no trained nurses, so he employed five Black women with nursing experience who did the bulk of the work. In 1886, he established a school of nursing, the first in the South. The students were white, since formal nursing schools for Blacks did not exist until the late 1890s (Figure 2) (9) He was an advocate of medical meetings and presented numerous papers on his cases and results. He was one of the first surgeons to adopt Lister's methods of antiseptic surgery and taught it to his students. Although he did general and gynecological surgery, he was especially interested in diseases of the bladder and prostate. (12) Of 60 medical papers published during his life, 28 involved urology. He advocated for the use of the recently invented cystoscope for the diagnosis and treatment of diseases of the bladder. He performed many suprapubic cystotomies to remove large bladder calculi and preferred to crush stones using a lithotrite given to him by Sir Henry Thompson (1820-1904).

McGuire's special interest was the surgical treatment of the enlarged prostate; "It has fallen to my lot in the last few years to meet with a number of cases of hypertrophy of the prostate gland which produced obstruction to the passage of urine" he wrote "Micturition is frequent and difficult, perhaps impossible without the aid of a catheter… and the general health suffers greatly". Endoscopic methods at the time were painful, caused considerable bleeding and were usually unsuccessful. Dr. McGuire resorted to open prostatectomy using a suprapubic, or perineal, approach, but he was unable to remove all the obstructing (median lobe) adenoma. This caused re-obstruction, forcing the patient back to the 'catheter life'. After failed attempts to enucleate the gland, he created a new type of diversion called an artificial urethra (cutaneous-vesicostomy), kept open with a silver plug. The patient simply removed the plug to void using his abdominal muscles and replaced it to remain continent (13).

McGuire held important posts in American medicine and surgery, including president of the American Surgical Association in 1887 and the AMA from 1893-1894. He emphasized that observation alone was inadequate to make advances in medical science. "We need the help of the biologist, the pathologist, the chemist," he wrote in 1887, "and that of every known science and art; indeed, there is no calling which demands wider and more comprehensive information." (14). He was acutely aware that science was necessary

for the surgeon "to save human life and lessen human suffering". His view of surgery was much broader than what was common in the 19th century and would usher in many changes to the 20th century (15). He founded a new medical school, the University College of Medicine, which later became part of Virginia Commonwealth University (16). In 1893, McGuire was elected president of the American Medical Association. In his inaugural address, he emphasized improved medical education and called for a national board of health. "Gentlemen, we must...strive through observation, and knowledge of the needs and demands of all sections of the country, for the things that are necessary not only for the preservation of health, but also for the highest conditions of physical and mental development". (17) McGuire was calling for doctors to preserve the good health and well-being of all citizens, North and South.

McGuire died after a stroke in 1900 at age 65. His friend, Dr. William Osler was one of his pallbearers. "To his funeral," wrote WL Peple in a subsequent homage, "the people flocked to do honor to his memory; men, women, and children, from every walk of life, and old comrades clad in gray."(18)

Hunter McGuire, the ignoble past.

McGuire's contributions to many in the classroom, in the battlefield and the civilian hospital are overshadowed by his legacy as one of the South's more published post-bellum racists. After the Civil War, many books were written, mostly in the North, where the South was villified. McGuire vehemently refuted such claims, and defended the aims and reputations of the leaders of the Confederacy. As chairman of the history committee of the Confederate Veterans of Virginia, he compiled a list of books to be banned, books that taught slavery was the main cause of the war. He wrote; "The South fighting for the money value of the negro! What a cheap and wicked falsehood. I intend to vindicate the South from the oft-repeated charge that we were the aggressors in bringing on the war. This will be my last labor of love for the dear Southern people." (7). McGuire asserted the South did not fight just to preserve the slave-dependent plantation economy. They were Virginians fighting to preserve their state's rights and 'way of life'.

In 1893, as president of the American Medical Association, McGuire co-authored an open letter outrageously titled "Sexual Crimes among the Southern Negroes" he which he cloaked his deep-seated racism with the loosest interpretation of Darwinian conjecture. "It is the frightful suvival of the fittest."(6) In an example of mid-19th century editorial oversight, McGuire was allowed to publish his suggestion that castration for Black men, but not for white men, be a penalty for convicted sexual crimes.

McGuire wrote an introduction to a 1901 racist book, *The Old Plantation; How We lived in the Great House and Cabin Before the War*, by James B. Avirett. The book was written to counter Harriet Beecher Stowe's *Uncle Tom's Cabin* which figured prominently in exposing the ante-bellum American reader to the cruelties and immorality of slavery. McGuire's racism was further hardened by ignorance and stupidity writing that " the institution (of slavery) had knit the hearts of the two races together too tenderly, in the happy life of the old plantation. The negro of the South today knows, that when in trouble his best friend is his old master...; and if left alone by those who understand neither race in the South, he would reflect this knowledge in all the relations of life and the race problem of the South would be solved – not in the penalties of odious lynch law, but in the displacement of the fiendish crimes which lead up to it".(5)

Since the Charleston Church shooting of 2015, more than 140 Confederate memorials have been removed from public land.(19) In July, 2022, Circuit Court Judge David Eugene Cheek Sr. ruled that Richmond would be allowed to removed the monument to its "last-standing Confederate statue", that of General A.P. Hill. Behind the capital building itself, however, still sits the statue of Hunter McGuire. Erected in 1904, the bronze sculpture rests on a granite base with the inscription, "To Hunter Holmes McGuire, M.D., LL.D. President of the American Medical and the American Surgical Associations, Founder of the University College of Medicine. Medical Director, Jackson's Corps Army of Northern Virginia; An eminent civil and military surgeon and beloved physician; An able teacher and vigorous writer; A useful citizen and broad humanitarian; Gifted in mind and generous in heart, This monument is erected by his many friends"(Figure 3).(2)

A 2020 criticism of McGuire was by the Richmond Times-Dispatch Pulitzer prize winning columinist, Michael Paul Williams. "Dr. Hunter Holmes McGuire's racism does not merit honor. Remove his name from Richmond spaces." He deplored the statue's presence, citing McGuire's "unrepentent racism as a pusher of eugenics pseudoscience and Lost Cause propaganda..."(3). McGuire's published works, as president of national organizations, bordered on being a "lynching apologist". "In 1899, McGuire was at the forefront of not only purging textbooks with any mention of slavery as the cause of the Civil War but also railed against 'suffrage for the blacks.' "(3)

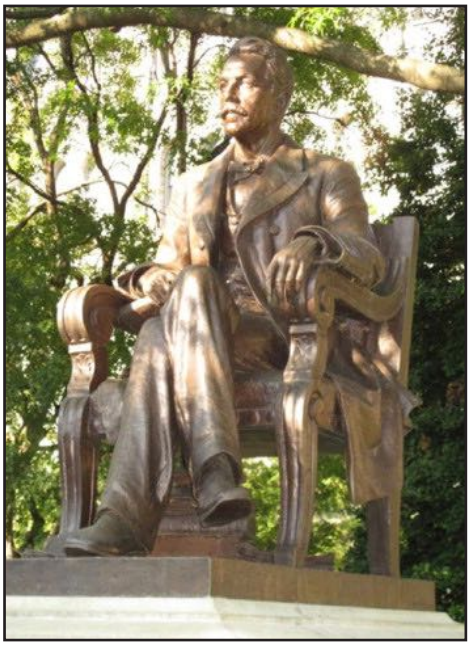

Figure 3. Statue of Hunter H McGuire, Capital Square, Richmond, VA. According to one biographer, ""There he sits, calm, dignified, reserved; just as he sat listening to the tales of suffering of his people—counselling, advising, always helping, giving."(18) (Photo, the Historical Marker Database, HMdb.org)

McGuire's decendents, Alice McGuire Massie, William Reed McGuire, and Hunter Holmes McGuire III, published a column voicing their support to remove the statue. "History will judge McGuire," they hoped "(as) a surgeon, based on his complete life and contributions. The family understands that statues and buildings honoring Confederate leaders have caused pain to fellow Americans and we support removal of the McGuire memorial."(4)

McGuire was recognized nationally and internationally for his significant contributions to the delivery of medical care on the battle field, and advances in surgery, anesthesia, and medical education. To his white contemporaries, he was a gifted surgeon, teacher, humanitarian, and a Virginian but born, bred and wrapped in the privileged culture of the slave-based economy of the 19th century American South. The largest federal medical facility in Richmond, Virginia, with 400 beds and occupying 1 million square feet, is still named after Hunter H McGuire.

CONCLUSIONS:

Hunter McGuire's medical achievements were initially lauded by 19th century colleagues while ignoring or down-playing his racist attitudes.(8,9) McGuire campaigned against the suffrage of Black Americans, espoused the genetic and moral inferiority of Blacks, and advocated castration for sexual crimes, while ignoring the lack of due process and a fair trial to many may wrongfully accused of such crimes.(9)

Hunter McGuire may have been a compassionate physician, gifted surgeon, coveted teacher to southern whites, and to those who called him "a generous 'humanitarian', yet he was a Southerner, who clung to the archaic values of the old South. As the former mayor of New Orleans said in 2017, "The Confederacy was on the wrong side of history and humanity. It sought to tear apart our nation and subjugate our fellow Americans to slavery. This is history we should never forget and one that we should never again put on a pedestal to be revered." (20) "Civil War figures aren't one-dimensional," wrote another journalist. "Many 'great' individuals can be faulted for beliefs or acts in their past, but should such 'vices' disqualify historical figures from favorable commemoration?" (21) Personal flaws in an individual's past, judged by today's values, may outweigh and/or diminish their significant contributions. A racist like McGuire put in a leadership position, especially one in a nationally preeminent surgical and medical organization, has the potential to cause much damage. McGuire's

case illustrates that conflict, weighing their significant contributions to the betterment of some while potentially harming others through the ignorance, fear-mongering, and sterotyping bias that underlies racism in many forms.

There is no evidence that McGuire owned slaves but he remained a pro-slavery advocate his entire life and lamented the freedom and enfranchisement of former slaves. The McGuire statue was erected to honor his contributions to medicine and not to remind the world of his unrepentant racist beliefs. The monument still stands as "a reminder of a long-since-past Richmond …"(22) And it may stay for some time since the recently elected Governor of Virginia not only appointed a historian who defends the statue, but believes "we must not overlook or excuse the sins of our past but we must resist the movement to cleanse our history ". (23) Still, the effects of racism that began with the very founding of the American colonies still holds an insidious grip.

The taking of the Hippocratic oath is a 2000 year old tradition and McGuire may have sworn to uphold its tenets upon graduation from the pre-Flexnerian medical schools of the 1850s. The oath has many principles including a moral dedication to cultural equanimity, that of delivering medical care regardless of a patient's social or ecnomic standing. "ἐς οἰκίας δὲ ὁκόσας ἂν ἐσίω," Hippocrates was said to write in the 5th century BCE, "ἐσελεύσομαι ἐπ᾽ ὠφελείῃ... ἐλευθέρων τε καὶ δούλων." (Gk: "Into whatsoever house I enter, I will enter to help the sick...whether they be free men or slaves"). (24) McGuire's ultimate place in history, like that of his Confederate contemporaries, may be relegated to the darker chapters of the American past. His significance now may have been ironically limited by the yolk of racism he so vigorously defended. Unable to uphold the provisions of the Hippocratic oath, McGuire was willing to do good for some, but not for all.

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