APRIL 2024
SCIENCE THROUGH TIME

***EDITORS IN CHIEF*:** Sheli Patel, Jessica Philipsz

***DIGITAL PRODUCER*:** Sheli Patel

ENGINEERING/TECH

EDITOR - Mihir Kandi

WRITERS

Kohei Dunkley
- "Bitcoin through Time"

Susanna Law
- "Timeline of the Pacemaker"

Bayley Northern
- "Neural Networks through Time"

LIFE SCIENCE

EDITOR - Jasmine Campion

WRITERS

Fletcher Bradford-Parnell
- "The Science of Love"

Emaan Mahmood
- "Darwin's theory of evolution
and the work of Watson and Crick"

MEDICINE

EDITOR - Kayan Ranina

WRITERS

Josh Obi
- "Otzi the Iceman"

Garshana Ramanathasan
- "Nazi Reproduction"

Meshayel Shah
- "History of Surgery"

PHYSICAL SCIENCE

EDITOR - Caitlyn Beacall

WRITERS

Alexander Busby
- "History of the Small"

Jessica Philipsz
- "Gravity through Time"

ENGINEERING/ TECHNOLOGY
LEAD EDITOR: MIHIR KANDI

NEURAL NETWORKS THROUGH TIME
By Bayley Northern

Introduction
With the recent rapid developments in AI, now widely available to the public, many people believe that AI is a relatively new invention: a concept conceived only in the last few decades. However, Artificial Intelligence, not just as a concept, dates to the 20th century, with theories about neural networks being first created in the 19th century.

What is a Neural Network?
Fundamentally, a neural network is just a group of interconnected nodes or neurons. Despite it being a model used to create most forms of AI, this model comes from biology, and it is how we understand our brain to work. However, artificial neural networks use mathematical models instead of cells; attempting to recreate the processes which allow us to think by communicating between "layers" of these nodes using mathematical functions.

The Conception
In 1873, Alexander Bain proposed the idea that human thought came from the interactions of neurons in the brain. This idea was developed in 1949, when Donald Hebb suggested the idea of Hebbian learning, which involves neural networks learning by strengthening connections when they "fire".

The Perceptron
Eventually, the first implemented artificial neural network had to be created. In 1943, the idea of a simple neural network, the "perceptron", was proposed by Warren McCulloch and Walter Pitts in 1943. It was finally implemented by Frank Rosenblatt in 1957. The perceptron could recognise patterns, giving it the ability to split images into two classes. This seemed incredibly promising. The New York Times said that the perceptron is: "the embryo of an electronic computer that [the Navy] expects will be able to walk, talk, see, write, reproduce itself and be conscious of its existence."

The Winter
However, the perceptron couldn't be trained to recognise a large variety of patterns. Many countries lost hope and subsequently stopped funding the AI related projects around 1970 as it had not "produced the major impact that was promised". This caused development to stall in across the world.

The Breakthroughs
Eventually, enough key developments were made and major countries were recognising the potential of neural networks. Along with the increase in computing power, crucial algorithms were created such as the backpropagation algorithm (which uses calculus to allow the neural network to learn) By the 1980s government funding was being provided again. This revolutionised most industries, including helping biologists figure out the development of proteins in 1988, predicting the stock market and an almost self-driving car in 1995.

Today's neural networks
This culminated recently in the development of the transformer model in googles' paper "Attention Is All You Need" in 2017. This is the model which the infamous ChatGPT (Generative Pre-Trained Transformer) which has become increasingly popular recently, taking the world by storm. The future of AI is even more promising, due to advancements in image and video generation in the coming years or decades.

Glossary
Artifial - made by people, often as a copy of something natural.
Neurons - the cells responsible for receiving sensory input from the external world.
Embryo - a thing at a early stage that shows potential for development.
Calculus - a branch of mathematics that deals with rates of change.
Biologists - an expert in or student of the branch of science concerning living organisms.

BITCOIN THROUGH TIME
By Kohei Dunkley

Introduction:
Bitcoin is a digital currency existing solely online. It relies upon a public ledger called the 'Blockchain' to record transactions securely and anonymously. The digital currency recently celebrated its 15th birthday, and its journey on the markets has been nothing short of volatile.

How did it all start?
In early 2009, Bitcoin's anonymous creator, Satoshi Nakamoto would launch the Bitcoin network, a network of computers worldwide that would maintain the Blockchain. Bitcoin aimed to fix the problems of traditional fractional-reserve banking, emerging just a year after the 2007/08 financial crisis that shook the world.
The Bitcoin network is a decentralized P2P (peer-to-peer) network, allowing transactions to be undergone between individuals, safely and securely without authority relying upon intermediaries such as banks.

The early years of Bitcoin (2009-2012)
In its infancy, Bitcoin experienced slow growth and adoption by users. Still being a very new technology, Bitcoin was substantially confined to the tech community. Many early adopters of Bitcoin would experiment with performing transactions over the network, even though Bitcoin initially had very limited monetary value. While still in an experimental stage, Bitcoin's popularity grew relatively slowly until it suddenly became payment method for real world transactions.

Becoming Mainstream (2013-2017)
Bitcoin became more accessible from 2013 onwards as an increasing number of exchanges began to offer the coin; most notably Mt. Gox which would find itself responsible for 70% of transactions on the Bitcoin network. Businesses were also beginning to accept the digital currency as acceptable payment – even flagship retailers like Dell and Microsoft were taking Bitcoin.
Ordinary people were also given the opportunity to invest in the currency although the markets were extremely volatile, as heavily proven in the following years.

Increasing Regulation (2017-2021)
With the usage of Bitcoin at its highest ever point, many countries such as Japan, Russia, the UK and US sought to regulate the asset. Due to Bitcoin's transactional anonymity, It was commonly used for illegal activities such as money laundering and black market transactions.
Newly imposed regulations from many countries would aim to put an end to this. Exchanges would no longer be able to sell digital currencies such as Bitcoin to customers without prior proof of identity.
As time went on, Bitcoin would see it's demand as an alternative payment method dwindle however it's importance as an investment asset would remain unchanged.

Bitcoin in the present and Future (2021 onwards)
With Bitcoin's ever increasing mainstream acceptance, as evidenced by large investments from companies such as Tesla and its adoption as legal tender in the country of El Salvador, Bitcoin is poised to remain a significant investment asset and will continue to shape the financial landscape of the future.
Bitcoin will undoubtedly be here to stay for many years to come.

Glossary
Money Laundering - disguising financial assets so they can be used without detection of the illegal activity that produced them.
Infancy - the early stage in the development or growth of something.
Monetary - relating to money, especially the total amount of money in a country.
Imposed - to officially force a rule, tax, punishment, etc. to be obeyed or received

TIMELINE OF THE PACEMAKER
By Susanna Law

Timeline of the Pacemaker
A pacemaker is a group of cells that causes the heart's chambers to contract, setting a regular heart rate. The heart's natural pacemaker is controlled by the sinus node which works by utilising electrical impulses and depolarization (when the charge within a cell changes), allowing a regular sinus rhythm to occur. However, cardiac conditions such as atrial fibrillation**(1)** or sick sinus syndrome**(2)** that causes bradycardia **(3)** (which is the slowing of heart beats) requires an artificial pacemaker to provide an adequate heart rate and regulate the electrical pulses delivered to the chambers of the heart.

The history of the pacemaker begins in 1928 where Mark Lidwell used electrical stimulation to save a child born in cardiac arrest. Four years later in 1932, Albert Hyman became interested in intracardial therapy**(4)** where he tried using stimulant drugs to restart the heart and soon realised that the drug proved no significant progress. The heart had only restarted due to a hole in the heart that produced a current made by a needle, and thus invented the first artificial pacemakers.

The first artificial pacemaker utilised electrical impulses directed into the heart's right atrium through the spaces within the ribcage (the intercostal space). However, this proved to be difficult as the pacing could only be delivered at rates of 30, 60 or 120 impulses per minute (due to the interaction it had with the magneto-generator (a device producing periodic pulses)). As social opposition rose due to his experiments being rejected from The Journal of the American Medical Associations, no one agreed to manufacture as it was found to be ineffective and unfavourable, thus leading to progress stalling.

In 1940, Wilfred Bigelow and John Callaghan started using hypothermia to produce bradycardia to permit cardiac surgery (to demonstrate the effects of cooling the heart prior to surgery). However, this caused cardiac contraction rapidly which often caused bradycardia. Bigelow later started experiments with Sino-atrial node stimulations (poking the heart with nodes to generate electrical impulses) which was the area which was thought to have regulated the sinus rhythm.

Breakthrough
In 1949, during an operation on a dog operated by Bigelow, the heart of the dog had suddenly stopped. Bigelow recounts: "Out of interest and in desperation, I gave the left ventricle a good poke with a probe I was holding. All four chambers of the heart responded. Further pokes clearly indicated that the heart was beating normally with good blood pressure."**(5)**

During the 1940s and 50s the principal device was invented with the ability to stimulate the heart using a direct current. This was when John Hopps was recruited and invested in a unit which used electrical impulses transmitted through a bipolar catheter electrode rather than a magneto-generator. The atrial pacing (a method in which surgeons inserted a lead to decrease the chances of atrial fibrillation occurring (heart beating irregularly)) could now be controlled without the need of uncomfortable chest wall contractions.

Pacemakers in the present
In the later years, three landmarks first would occur: the first battery-operated wearable pacemaker, the first long term correction and the first implantable pacemakers. This greatly improved the portability of pacemakers with most being completely hidden and controlled moment. The 2000s introduced synchronisation in the heart's contractions which improved contraction and survival rates for heart failure which greatly improved the health of those living with atrial fibrillation and sick sinus syndrome. Current development in pacemakers involves leadless pacemakers as well as the possibility of permanent pacemakers being installed.

Glossary
Contract – decrease in size
Sinus Node – generates an electrical signal that causes the upper heart chambers (atria) to contract.
Stimulant – a class of drugs that speed up messages travelling between the brain and body.
Porability – the quality of being light and small enough to be easily carried or moved:
Cardiac – having to do with the heart.
Adequate – there is enough of it or it is good enough to be used or accepted.

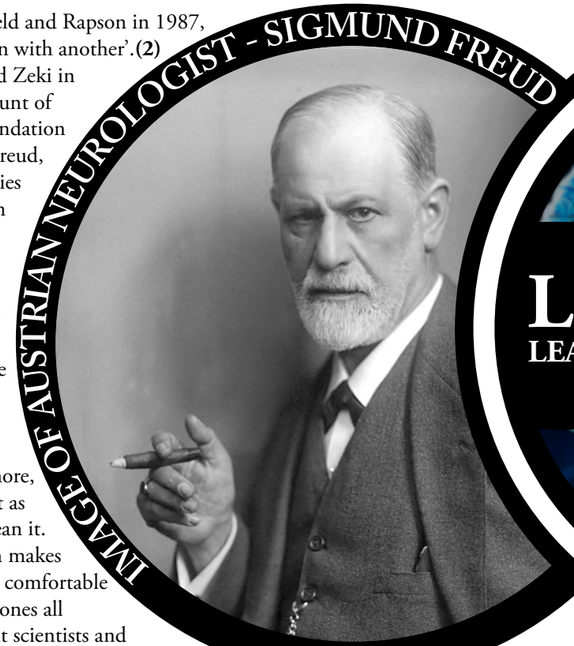
LIFE SCIENCE
LEAD EDITOR: JASMINE CAMPION

THE SCIENCE OF LOVE
AND HOW IT HAS CHANGED OVER TIME
By Fletcher Bradford-Parnell

Ancient Greeks viewed love in many different ways and had different terms for love towards family members, friends, and partners. This was the beginning of the concept of “love”, and it has now evolved to scientists being able to explain the reasons behind love and give a clear definition. Lots of research has been done in recent years to build a better understanding of love and build on the foundation that the ancient Greeks created.

The ancient Greeks split love into 7 separate types with romantic love falling under several of these categories such as Philia, Agape, and Ludus.**(1)** Philia is the Greek term for love that is not defined by physical attraction but refers to affectionate love between equals, for example between two good friends. Agape is a type of unconditional, selfless love towards someone else. Ludus is what modern day people would call a crush, the emotions felt when you first like someone. Although the Greeks did not have a concrete idea of why we felt love they did understand what it was and that all animals on earth, including humans, could feel it. These ideas created a foundation of what love is for thousands of years to come, and although the ideas changed over time, they provided a basic understanding about the concept of love and why we feel it.

The term romantic love was first defined by Hatfield and Rapson in 1987, where it was defined as ‘an intense longing for union with another’.**(2)** Studies continued into modern day with Bartels and Zeki in 2000, the work of Fehr in 2013 and 2015. The amount of research done in recent years all builds upon the foundation laid by the Greeks and psychologists like Sigmund Freud, showing how science has evolved across time and relies on ideas and research from the past to create modern science and link science across time altogether to create accurate theories.**(3)**



These studies have revealed that hormones play an important role in causing us to feel love with different hormones changing both what intensity the love is, and the type of love. Research has shown that when people fall in love or have a crush the hormone dopamine is released, this is a chemical in the brain that makes people feel happy.**(4)** Furthermore, science has shown that dopamine has the same effect as cocaine so when people say “love is a drug”, they mean it. Oxytocin is another type of hormone released which makes people feel relaxed, one reason why people feel most comfortable and happy around the people they love. These hormones all released at the same time give this feeling of love, but scientists and psychologists still don’t know what love is exactly, however there has still been immense development of our understanding from what we gained from the Greeks, leading to modern day ideas, which will help scientists to classify love for years to come until new research is introduced, and the definition or reasons may change.

In conclusion, love has been defined in many different ways from the ancient Greeks to modern day, but scientists now know that although the Greeks were correct, with modern science and research done into hormones we have finally discovered some of the causes of love which were previously unknown.

Glossary

Hormones - chemical substances that act like messenger molecules in the body
Intensity - the measurable amount of a property.
Psychologist - a person who specializes in the study of mind and behavior or in the treatment of mental, emotional, and behavioral disorders.
Immense - extremely large or great, especially in scale or degree.
Foundation - an underlying basis or principle.

DARWIN'S THEORY OF EVOLUTION AND THE WORK OF WATSON AND CRICK - THE STRUCTURE OF DNA
By Emaan Mahmood

What is evolution?

We all have a general idea of what evolution is, in fact the Oxford dictionary defines evolution '' as the process by which different kinds of living organisms are believed to have developed from earlier forms during the history of the earth.''. Take the dinosaurs - a classic example - they were believed to be the early **ancestors** of the birds we see today, and this can be shown and explained by the work of Charles Robert Darwin. Evidence has become more and more abundant and irrefutable through time such as the discovery and study of fossils. However there is also the work of James Watson and Francis Crick, who ascertained the structure of DNA and established the foundation of the understanding of genetics. Their research plays a major role in how we can explain the theory of evolution today, and goes to show how two different discoveries both can support and coincide with each other. It is the appreciation of this relationship, linking scientific discoveries together, that will help us make more discoveries in the future!us make more discoveries in the future!

So what were the common beliefs before the work of Darwin, Watson and Crick?

Before..

First it needs to be established that Charles Darwin and Watson & Crick were not scientists of the same time or era. Crick and Watson lived and worked primarily in the mid-20th century whereas Darwin lived and worked during the 19th century in the Victorian era.

Before the theory of evolution was first accepted, people believed in many creationist explanations for the diversity and origin of life on Earth. Generally , all these explanations revolved around the idea that everything was created by a **deity** or **deities** in their current form and that they did not change over time. As stated by the American natural museum of history people believed ‘species were not linked in a family tree’.**(1)**

Similarly, before the structure of DNA was discovered, people had many different explanations when it came to inheritance and heredity too. For example,"Blending inheritance" was one of these explanations and suggested that the traits from parents blended together in their children.

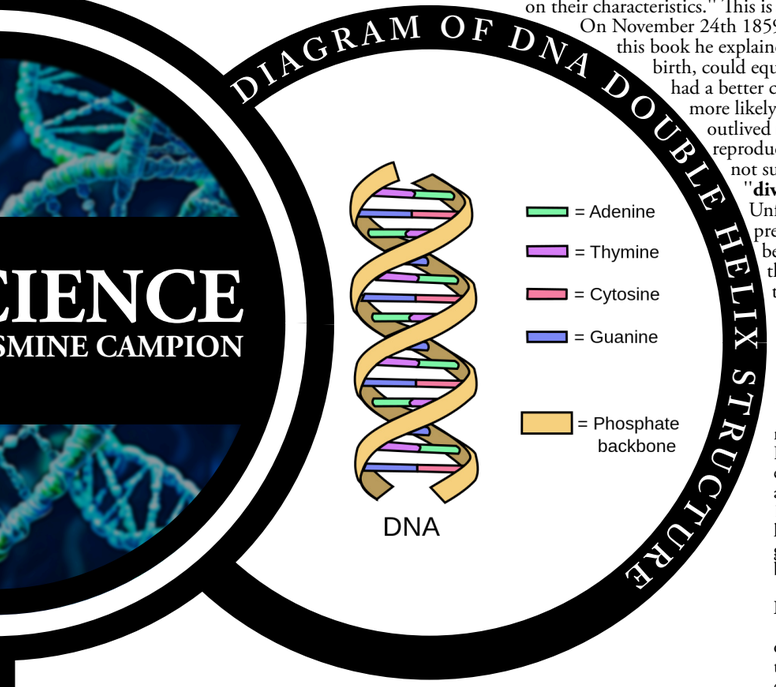
Charles Darwin (1809-82)

The concept that Charles Darwin proposed was that '' individuals are born with variations that make some of them more likely to survive and pass on their characteristics.'' This is also known as the process of natural selection.

On November 24th 1859, Darwin published his book On The Origin Of Species. In this book he explained how a chance mutation, spontaneously occurring at birth, could equip some organisms with a characteristic that meant they had a better chance of survival. Thus meaning that the characteristic is more likely to be passed on to their offspring because they have outlived their competitors and so have survived long enough to reproduce more. However, different mutations could either suit or not suit certain conditions, so species would eventually ''**diversify**'' and become adapted to suit specific habitats.

Unfortunately, if the conditions of the habitat changes then the previously advantageous characteristics the organism had may become a weakness, causing the species to die out. We can see this happening with some animal populations decreasing today due to climate change.

The interesting thing about Darwin's theory is that the mechanism he proposed worked for all of life, and suggested that every single organism is descended from a common **ancestor**.**(2)**



Journey to discovery (1831-36)

Darwin, who had trained as a doctor before starting his research, embarked as a **naturalist** on a voyage aboard the HMS Beagle. This voyage ''sowed the seeds'' for his theory of evolution by natural selection which he revealed in 1858. He also applied his theory to humans in The Descent of Man , in 1871.**(3)** Whilst aboard the Beagle, Darwin was notorious for his craving for exotic foods! He ate pumas, iguanas, armadillos, giant tortoises, and a 20-pound rodent he described as “the best meat I ever tasted.”**(4)**

Francis Crick and James Watson

The pair are best known for the uncovering of the structure of DNA in 1953. However before that, in 1950, advances in technology were made so that DNA (deoxyribonucleic acid) could be examined in as a three dimensional shape - revealed via X-ray crystallization. Their results from trying experimental new methods revealed to the scientists that DNA had a helical structure - simply put it is two coiled chains with '**variable** components' that hold the chains together.

These **variable** components are known as bases, they are called adenine , guanine , thymine and cytosine, and they are **variable** in the sense that they are randomly positioned on one length of the chain. However, Watson and Crick found that the varieties of bases were always in fixed proportions. Eventually, they were convinced that this was because the bases bonded to other bases in fixed ways. For instance, adenine with thymine and guanine with cytosine.

This key understanding is what helped us to understand how DNA carried our inherited information and also how this information is replicated and ''passed on'' to our offspring through reproduction.

This links well with the work of Darwin and now we understand that it is the rise of mutations in DNA that means that some offspring are given different traits which may or may not suit them to the specific conditions in habitats.**(5)**

Glossary

Ancestor : a person, typically one more remote than a grandparent, from whom one is descended Or a person who was in someone's family in past times before grandparents.
Deity : the creator and supreme being (in a monotheistic religion such as Christianity).
Diversify : make or become more diverse or varied.
Naturalist : an expert in or student of natural history.
Variable : not consistent or having a fixed pattern; liable to change.
Helical : having the shape or form of a helix; spiral.
Mutations : the action or process of mutating or the changing of the structure of a gene, resulting in a variant form that may be transmitted subsequent generations, caused by the alteration of single base units in DNA, or the deletion, insertion, or rearrangement of larger sections of genes or chromosomes.

MEDICINE

LEAD EDITOR: KAYAN RANINA

ÖTZI THE ICEMAN
AND A PREHISTORIC LOOK ON MEDICINE

By Josh Obi

The history of medicine is a testament to humanity's quest for understanding and alleviating ailments in the human body, from ancient remedies to modern breakthroughs. While celebrated figures like Hippocrates, Vesalius, and Pasteur, often dominate historical narratives, the prehistoric era largely remains an underexplored realm. However, recent advances in analysis techniques, such as genome analysis and radiocarbon dating, have shed light on this era - notably through the discovery of Ötzi the Iceman and unique insights into prehistoric medical practices.

The development of humanity has been a tale of humans exerting a greater influence over the natural environment, including themselves - and medicine has certainly not been independent of this trend. All of these facets of individual brilliance have collated into what we know now as the field of medicine, yet the prehistoric era is often overlooked in this deep dive into the field. Representing an era without any written history, it has often been simply left as unexplorable, and solemnly lost in the abyss of time. However, through improved analysis techniques this era no longer represents a mystery.

Found on 19 September 1991 in the Otztal Alps on the Austrian-Italian border, an extraordinary discovery through the Tyrolean Iceman Ötzi was made. As the world's oldest glacier mummy, living roughly 5,300 years ago (Kutschera, n.d.), the glacial conditions preserved much of his tissues, bones and organs, providing the perfect opportunity for analysis.

Ötzi's discovery provided an unprecedented opportunity to study the medical practices of Copper Age communities and given the sophisticated set of tools and remedies that Ötzi wielded, it is not a stretch to extend that Ötzi belonged to a society with a surprisingly advanced health care system for its time.

The examination of the osteons (functional units of bone) in Ötzi's femur put his age likely to be around 45 years old when he died, which would have been a good life expectancy 5300 years ago (Karydi et al., 2022). However, Ötzi was a medical mess. Mitochondrial DNA analysis traces the bacterium responsible for Lyme disease in Ötzi's bones (University of Toronto News, n.d.), hinting towards why he suffered from bone loss. Yet this wasn't his only problem, as he suffered from a bad stomach bug, and not to mention an arrow in his back - this probably killed him.

Yet Ötzi was not ignorant in his suffering, and evidence suggests that there were some early medical practices to alleviate symptoms common in the Copper Age. Birch polypore fungus (Peintner, Pöder and Pümpel, 1998), discovered tied to his leather bands, has been found through modern chemical analysis to possess medicinal properties, acting as an antibiotic and anti-inflammatory agent. His ingestion of toxic bracken fern suggests early attempts at treating tapeworms, while traces of bog moss indicate makeshift bandages.

Furthermore, Ötzi's tattoos offer intriguing insights into prehistoric medical practices. In total 61 tattoos were found, consisting of lines and crosses, and made through making small incisions traced with charcoal (Meilan Solly, 2018). Placed near joints or injury-prone areas, researchers speculate they might have served a therapeutic purpose similar to acupuncture, aiming to relieve pain or aid healing.

Ötzi's case underscores the sophistication of medical practices in prehistoric societies. Far from primitive, these communities employed a range of treatments and techniques to address health concerns. Through sophisticated use of plants and fungi, it is suggested that Ötzi was part of a culture with some knowledge of anatomy and how diseases arise.

Glossary

Acupuncture - Practice of penetrating the skin with thin needles to stimulate sensory nerves under the skin and in the muscles.
Femur - Longest and strongest bone in the human body.
Hippocrates - Greek Physician known as the 'Father of Medicine' for his contributions to advancing the systematic study of medicine and changing attitudes at the time.
Lyme disease - Bacterial disease which is transmitted to humans through ticks.
Mitochondrial DNA - Circular chromosome found inside the cellular organelles called mitochondria.
Osteons - Cylindrical, functional units of bone.
Pasteur - French Chemist, pharmacist, and microbiologist renowned for his discoveries of the principles of vaccination, as he developed vaccinations for anthrax and rabies.
Vesalius - Anatomist and physician that put anatomy at the forefront of medical study and stressed the importance of direct empirical observation through carrying out dissections.

THE HISTORY OF REPRODUCTIVE MEDICINE
IN THE NAZI ERA

By Garshana Ramanathasan

Shocking evidence of the combination of science, ideology, and violations of human rights may be found in the history of reproductive medicine during the Nazi era. In pursuit of a eugenics-driven vision, policies aiming at promoting 'racial purity' and limiting human reproduction were implemented during this period.

Systematic, forced sterilisation programmes were the foundation of Nazi reproductive medicine. The Law for the Prevention of Hereditarily Diseased Offspring, passed by the Nazis in 1933, permitted the compulsory sterilisation of people who were thought to be genetically 'undesirable'. People with mental illnesses, impairments, and suspected inherited disorders fell into this category. Thousands of people were sterilised because of this law's implementation, depriving them of their right to reproduce and allowing flagrant human rights violations to continue.

To further their racial objective, the Nazis also attempted to control reproductive habits. The Lebensborn programme was a prime example of this strategy; it aggressively suppressed reproduction among people who were considered racially inferior while promoting reproduction among racially 'pure' individuals. In the meantime, as part of the homicidal policies of the Nazi dictatorship, members of excluded populations such as Jews, Roma, and others experienced persecution, forced sterilisation, and ultimately genocide.

Brutal human experimentation also corrupted reproductive medicine during the Nazi era. In concentration camps, Nazi medical professionals carried out immoral experiments such as forced sterilisations, hormone treatments, and other reproductive manipulation procedures. These experiments constituted severe breaches of medical ethics and human dignity because they were carried out without consent and frequently resulted in severe suffering or death.

Moreover, reproductive genetics played a role in the Nazi goal for racial hygiene. Fake scientific concepts of racial superiority and inferiority influenced genetics and heredity research, with Nazi scientists trying to find and eliminate characteristics deemed undesirable.

This history of reproductive medicine in the Nazi era clearly is seen to affect the present day as well. Germans have lately banned several procedures that would have been beneficial to both parents and children, having been overpowered by the eugenics of the Nazi era. Examples include the need that doctors transfer all embryos they are able to develop, regardless of quality - which leads to Germany having one of the highest rates of multiple births in Europe. Another example is the freezing of embryos for use at a later date. Cloning, surrogacy, and egg donation are also prohibited.

In conclusion, the history of reproductive medicine during the Nazi era should frighten us about the dangers of letting ideology and a lack of moral principles override science. We must acknowledge the lasting effects of eugenics during this painful historical period and make a commitment to upholding the principles of medical ethics, human rights, and dignity for everyone, regardless of race, nationality, or disability. Therefore, research is essential because without knowledge of the reasons behind the actions of German physicians in the past, the public will find it difficult to make decisions on the ethical dilemmas that modern gynaecologists, embryologists, and reproductive scientists face.

Glossary

Eugenics - how to arrange reproduction within a human population to increase the occurrence of heritable characteristics regarded as desirable
Genocide - the deliberate killing of a large number of people from a particular nation or ethnic group with the aim of destroying that nation or group
Surrogacy – the process of a woman bearing a child on behalf of another person or couple.

SURGERY THROUGH HISTORY

By Meshayel Shah

The history of medicine is a captivating journey that unfolds over thousands of years, as shown by remarkable developments and transformations. From ancient civilizations where methods such as trepanning were used to treat seizures, to the present day where heart transplantations allow us to live up to an extra 10 years. The evolution of medicine throughout time reflects humanity's relentless pursuit of understanding healing and improving health; however, some of the pioneering advances in medicine would not have been possible without the advances in surgery.

Surgery, a branch of medicine that is usually seen as the most thrilling and exciting by modern day society, was not always looked upon this way. Instead, it was viewed as a highly distasteful and crude occupation in its early days of development and was looked down upon as a profession. Surgery is as old as humanity, for anyone who has ever stanched a wound has acted as a surgeon. In some ancient civilizations surgery reached a prominent level of development (Editors of Britannica 2019).

The origins of surgery can be traced back to ancient civilizations such as Egypt, Mesopotamia, India, and China. In these early societies, surgical practices were often intertwined with religious rituals. Ancient Egyptian medical texts provide insights into surgical techniques used to treat injuries, fractures, and other ailments. Similarly, ancient Indian texts detail surgical procedures like rhinoplasty and cataract removal. Ancient Greeks also performed some surgical procedures including setting broken bones, bloodletting, draining lungs of patients with pneumonia, and amputations. Despite these advance practices that were ahead of their time, the risk of infection or death was still high. The leading cause of death in many of these surgeries was due to septic shock (Aurelia Clunie, 2014).

Surgeons of the Middle Ages were often 'barber-surgeons' who would travel and perform minor procedures including tooth extraction, bloodletting, and treating war wounds. Rather than studying at universities like physicians, surgeons learned through apprenticeship and observation. Surgery, without adequate anesthetics and antiseptics, remained dangerous. During the Middle Ages, surgical practice also faced challenges due to the dominance of religion - which restricted human dissection, limiting the understanding of anatomy and often leading to misconceptions which held back surgery in England. However, the Islamic Golden Age saw advancements in surgery, with scholars like Abulcasis contributing to the field through the invention of surgical scissors, grasping forceps and obstetrical forceps. His detailed descriptions of this surgical equipment were used in teaching and the manufacturing of the equipment itself (Amr, S.S. and Tbakhi, A. (2007)).

The Renaissance was a fervent period that marked a revival of interest in human anatomy and surgical techniques. One of the most prominent figures during this period was Andreas Versailles, often referred to as the 'founding father' of modern surgery, who accurately recorded and illustrated human anatomy based on his findings from autopsies and dissections (Erjavic, N. (2018)). The development of surgery was further aided by the invention of the printing press by Johannes Gutenberg in 1440, which facilitated the dissemination of medical knowledge leading to greater advances.

It was not until the 1800s that the likelihood of surviving surgery was greater than the likelihood of dying during or as a result of surgery. Even then, infection was common, and outcomes were poor. While shifts in anatomical knowledge empowered surgeons, many procedures remained out of reach. Surgeons were still unable to perform prolonged and complex surgeries due to the risk of infection and the pain patients felt without anesthetics. However, as the use of anesthesia in the late 1800s became more widespread, patients no longer had to fear the pain of an operation. However, the threat of infection still meant that surgeries had a high mortality rate.

In 1865, Joseph Lister, who believed microorganisms could cause disease, developed his method of "listerism". Lister recommended antisepsis, or the removal of bacteria from instruments, wounds, and the air above the patient (Clunie, A. (2014)). His process consisted of using carbolic acid as a sterilizing agent, but it was incommodious and many surgeons who did not accept germ theory refused it. However, by the 20th Century, asepsis, or the prevention of bacteria from entering a wound, gained prominence which eliminated the biggest cause of death in surgeries - infection. As the germ theory became widely accepted, the focus shifted towards providing a sterile environment to perform surgeries, leading to physicians wearing white coats and cleaning linen-dressed beds and operating tables. This final shift allowed for advancements in internal surgery and the success in the surgical procedures we see today.

Minimally invasive techniques, such as laparoscopy and robotic-assisted surgery, have revolutionized procedures a long way away from primitive surgeries that were performed without any anesthetics or proper infection controls. With ongoing research and development, modern surgery continues to push boundaries. We now see safer, more effective treatments for a wide range of medical conditions and improving overall patient outcome and quality of life.

Glossary

Ailments – illness, often one that isn't serious.
Cataracts – clouding of the lens of the eye.
Dissemination – the action or fact of spreading something, especially information, widely.
Facilitated – make (an action or process) easy or easier.
Fervent – displaying a passionate intensity.
Incommodious – causing inconvenience or discomfort.
Intertwined – to connect or link.
Laparoscopy - a surgical procedure in which a fibre-optic instrument is inserted through the abdominal wall to view the organs in the abdomen or permit small-scale surgery.
Rhinoplasty – surgery that changes the shape of the nose.
Stanch - to stop or restrict.
Septic – a serious condition in which the body responds improperly to an infection.
Trepanning – surgical intervention in which a hole is drilled or scraped into the human skull.

HISTORY OF THE SMALL

By Alexander Busby

We've never completely understood the fundamental building blocks of our world, but over time we've conceptualised and discovered new smallest things. This article aims to break down those discoveries in chronological order, from the Ancient Greeks to the **Cern particle accelerator (1)**.

Early Atomic History

The earliest recorded thoughts about the smallest object were "published" by Leucippus of Miletus in the 5th century BCE. Leucippus and his named the building blocks of science "atomos", literally "indivisible". He suggested that atoms were uniform, solid and indestructible and that their size and shape determined the properties of materials, for example sourness was caused by a sharp atomic shape.

When Leucippus' poem, "*De rerum natura*", was rediscovered in 17th century AD, it prompted a new revolution for experimental science **(2)**. One of the physicians that were affected by the poem's discovery was Robert Boyle, who began systemic research of air and vacuums. Boyle wrote that all matter is composed of solid particles, arranged into molecules to give a material its properties.

The Modern Atom

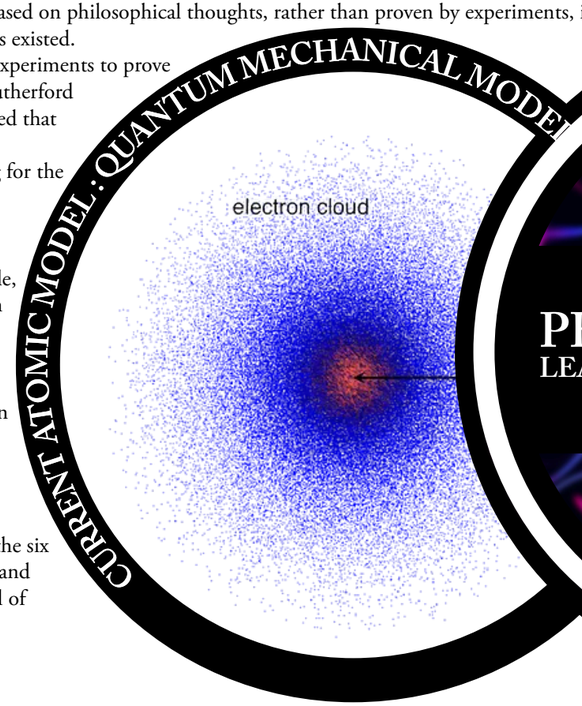
While all previous conceptions of an atom were based on philosophical thoughts, rather than proven by experiments, in 1803 John Dalton was the first to scientifically prove that atoms existed.

100 years later, JJ Thompson carried out various experiments to prove the existence of his theorised electron **(2)**. Ernest Rutherford conducted the gold leaf experiment **(3)**, which proved that atoms were mostly empty space.

In 1932, the neutron **(4)** was discovered, allowing for the development of our modern-day atomic model.

Dividing the Atom

While previously defined as an undividable particle, scientists wanted to figure out why atoms existed. In 1964 the first scientists, Murray Gell-Man and George Zweig proposed the concept of quarks **(5)**. In 1967, experiments to observe the effects of shooting electrons **(6)** at neutrons were conducted in the Stanford Linear Accelerator Centre **(7)**. The results of the experiment were unexpected and could only be explained by the existence of quarks. Throughout the 1970s, more experiments were completed to specifically prove quarks existing and the six "flavours" of quark (up, down, charm, strange, top, and bottom) were incorporated into the Standard Model of Particle Physics.



Where will particle physics go next?

A new area of physics being studied is string theory. This is the idea that inside of quarks, are 'strings' or 'filaments' that vibrate in a specific way to determine their properties.

Watch this video to learn more **https://www.youtube.com/watch?v=Da-2h2B4faU**

Conclusion

The voyage of discovery has been interesting, from Greeks theorising, to scientists verifying. The journey is still not over, string theory is actively being researched, among many other areas of particle physics and who knows where it will take us or what we will discover next.

Glossary / Bibliography

(1) Cern particle accelerator – piece of equipment used in particle physics

(2) Experimental science - a type of science that uses experiments to test hypotheses and observe facts

(3) Gold Leaf Experiment – experiment to find atomic structure **https://www.bbc.co.uk/bitesize/guides/zxkxfcw/revision/2**

(4) Neutron - A particle with mass but no charge, forms an atom along with protons and electrons.

(5) Quarks - tiny particles that make up larger particles, such as protons and neutrons, and give them their properties

(6) Electron - A tiny particle with negligible mass and a negative charge

(7) Stanford linear accelerator Centre – a piece of equipment used to study subatomic particles **https://www.asme.org/about-asme/engineering-history/landmarks/92-stanford-linear-accelerator-center**

GRAVITY THROUGH TIME

By Jessica Philipsz

Humans for countless millennia have been fascinated by the concept of gravity: from the ancient Greek Philosopher, Aristotle, theorising a 'natural motion' between objects; to the ancient Indian mathematician, Brahmagupta, who believed there was a fundamental attraction between all things (Tolentino, 2023). However, it was only after Newton in the 17th century that we see the first scientific explanation for this phenomenon; which was later advanced by Einstein in the 20th century, which is still considered true despite some modern questions.

Newtonian gravity

Newton's development of gravity arose amidst the Scientific Revolution during the 16th and 17th centuries, when he published The Mathematical Principles of Natural Philosophy (1687) (Westfall, 2019). He was the first to mathematically prove other scientists' ideas (Galileo, who recognised different masses fall at the same rate; Kepler, who studied planetary orbits) (Yasir, 2022). Newton's Law of Gravitation states that every object is attracted to every other object with a force that is proportional to its mass, essentially meaning the bigger the object's mass, the stronger the force of gravity (Newton and Thorp, 1777). Newton's Law of Gravitation was widely believed for 400 years; however, it did not consider massless light being affected by it (Bruce, n.d.), alongside studies from Einstein that proved it to be inaccurate under certain conditions: extremely large masses and speeds. Hypothetically, according to Newton, if one object were to move, the other should feel an immediate change faster than the speed of light. This is obviously not the case: Einstein believed the incorporation of time into this theory would solve this problem. (Dipu, 2015)

Theory of Relativity

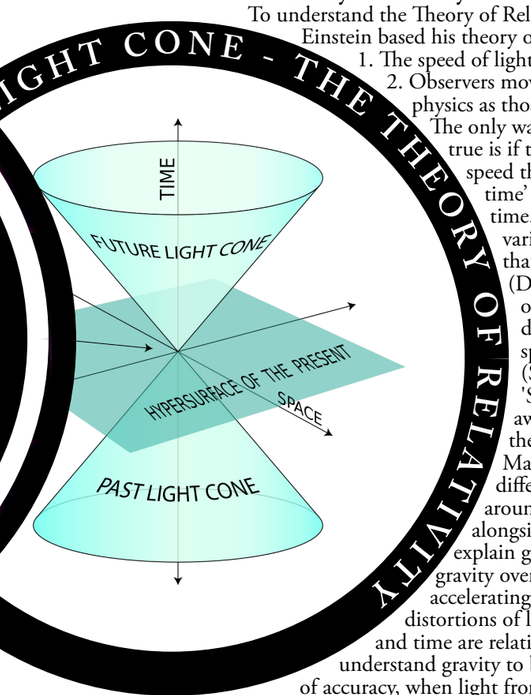
To understand the Theory of Relativity, we must delve into the concept of space-time. Einstein based his theory on two postulates:

1. The speed of light is the same in every situation
2. Observers moving at constant speeds experience the same laws of physics as those who are stationary (Dipu, 2015)

The only way that these two statements can be simultaneously true is if the speed that time is experienced changes with the speed the observer travels. The equation 'distance = speed x time' states that distance, or 'space', is proportional to time. Therefore, if the speed of light is constant and time varies with the speed of the observer, that must mean that space also varies with the speed of the observer (Dipu, 2015). This proposes an interconnected 'fabric' of space and time, introducing time as a fourth dimension. Hermann Minkowski, who theorised space-time, explained it rather dramatically like this (Sleator, 1996):

'Space by itself, and time by itself, are doomed to fade away into mere shadows, and only a kind of union of the two will preserve an independent reality'

Mass has its own interactions with space-time, creating different distortions in it, causing space-time to curve around objects of large masses. Einstein used this theory, alongside The Equivalence Principle (Overduin, 2019) to explain gravity: Motion of an object due to the force of gravity over a given distance is actually the motion of an object accelerating along the curvatures of space-time, created by the distortions of large masses. This Theory of Relativity (where space and time are relative to the speed of light) is currently how we understand gravity to behave and was proven in 1919 to a surprising degree of accuracy, when light from a star behind the sun could be seen from Earth (Urone and Hinrichs, 2020).



Glossary

Planetary Orbits: The shape of a planet's orbit around the sun

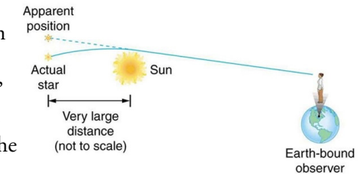
Postulate: A statement that is assumed to be completely true, that is used to understand other ideas

Constant: Remains the same

Quantum Particles: Particles that behave as both a wave and a particle, depending on how it is observed

The Equivalence Principle: An object that gravity is acted upon cannot be experimentally distinguished from an object that is accelerating

This phenomenon simply could not be explained with Newtonian gravity, as light does not have a mass. Furthermore, Einstein's theory gained credibility, as the starlight changed direction along the predicted curvatures of space-time.



We are far from understanding the complete nature of gravity. There are still many speculations on how gravity interacts with quantum particles: would gravity become 'quantized', or does quantum theory only apply at specific scales (Chiara Marletto, 2021)? As technology advances, these questions will be answered, but for now, Einstein's Theory of Relativity is the widely accepted explanation for gravity.

ENGINEERING/ TECHNOLOGY
LEAD EDITOR: MIHIR KANDI

FURTHER READING

1. 2008 Recession: What It Was and What Caused It -
https://www.investopedia.com/terms/g/great-recession.asp

2. Pacemakers—A journey through the years -
https://link.springer.com/article/10.1007/s12055-005-0060-0

3. Research Paper on Basic of Artificial Neural Network -
https://d1wqtxts1xzle7.cloudfront.net/33824099/Research_Paper_on_Basic_of_Artificial_Neural_Network-libre.pdf?1401389277

PHYSICAL SCIENCE
LEAD EDITOR: CAITLYN BEACALL

FURTHER READING

1. String Theory Explained – What is The True Nature of Reality?
- https://www.youtube.com/watch?v=Da-2h2B4faU

2. Career of Isaac Newton
- https://www.britannica.com/biography/Isaac-Newton/Career

3. The Fabric of Reality: Towards a Theory of Everything - David Deutsch (book) -
https://www.researchgate.net/publication/341215956_Einstein_Theory_of_Relativity

FURTHER READING
NSB SCIENCE JOURNAL

LIFE SCIENCE
LEAD EDITOR: JASMINE CAMPION

FURTHER READING

1. SCIENCE YEAR BY YEAR (book) - by Professor Robert Winston.

2. Amazing Evolution (book) – The Journey of Life by Anna Claybourne

3. Evolution (book) by Sarah Darwin, Eva Maria-Sadowski, and Olga Baumert (Illustrator)

MEDICINE
LEAD EDITOR: KAYAN RANINA

FURTHER READING

1. The Historical Timeline of Surgery -
https://www.verywellhealth.com/the-history-of-surgery-timeline-3157332
2. The history of surgery and surgical training in the UK -
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8377927/
3. History of Medicine 1800 -
https://www.britannica.com/science/history-of-medicine/Traditional-medicine-and-surgery-in-Asia

1. Further reading on Ötzi the Iceman - https://www.oetztal.com/magazine/otzi-the-iceman.html
2. Further reading on mitochondrial DNA -
https://www.cam.ac.uk/research/news/a-new-route-to-evolution-how-dna-from-our-mitochondria-works-its-way-into-our-genomes
3. Further reading on using osteons in bones to determine the age of death in adults
https://www.redalyc.org/journal/3438/343868237003/html/

ENGINEERING/ TECHNOLOGY
LEAD EDITOR: MIHIR KANDI

REFERENCES

Timeline of the Pacemaker By Susanna law

(1)https://www.nhs.uk/conditions/atrial-fibrillation/

(2)https://www.nhs.uk/conditions/pacemaker-implantation/why-its-done/#:~:text=In%20sick%20sinus%20syndrome%2C%20the,slower%20pulse%20than%20normal%20(bradycardia)

(3) Who needs them (no date) National Heart Lung and Blood Institute. Available at: https://www.nhlbi.nih.gov/health/pacemakers/who-needs#:~:text=The%20most%20common%20reason%20people,fast%20(tachycardia)%20or%20irregular. (Accessed: 17 March 2024).

(4) Aquilina O. A brief history of cardiac pacing. Images Paediatr Cardiol. 2006 Apr;8(2):17-81. PMID: 22368662; PMCID: PMC3232561.

(5) Aquilina O. A brief history of cardiac pacing. Images Paediatr Cardiol. 2006 Apr;8(2):17-81. PMID: 22368662; PMCID: PMC3232561.

Bitcoin Through Time By Kohei Dunkley

(1)https://www.pwc.com/us/en/industries/financial-services/fintech/bitcoin-blockchain-cryptocurrency.html

(2)https://www.investopedia.com/terms/g/great-recession.asp

PHYSICAL SCIENCE
LEAD EDITOR: CAITLYN BEACALL

REFERENCES

Gravity through Time By Jessica Phillipsz

Bruce, A.J. (n.d.). How does gravity alter the trajectory of light? [online] www.physlink.com. Available at: https://www.physlink.com/education/askexperts/ae661.cfm.

Chiara Marletto (2021). Quantum computers are revealing an unexpected new theory of reality. [online] New Scientist. Available at: https://www.newscientist.com/article/mg25033300-300-quantum-computers-are-revealing-an-unexpected-new-theory-of-reality/.

Dipu, R.A.M. (2015). Einstein: Theory of Relativity. [online] Available at: https://www.researchgate.net/publication/341215956_Einstein_Theory_of_Relativity DOI:10.13140/RG.2.2.10747.13607.

Newton, I. and Thorp, R. (1777). Mathematical Principles of Natural philosophy. Volume the First. [online] London: Printed for W. Strahan and T. Cadell. Available at: https://archive.org/details/bub_gb_Tm0FAAAAQAAJ/page/n47/mode/2up.

Overduin, J. (2019). GP-B — Einstein's Spacetime. [online] Stanford.edu. Available at: https://einstein.stanford.edu/SPACETIME/spacetime2.html.

Sleator, D. (1996). Hermeneutics of Classical General Relativity. [online] Nyu.edu. Available at: https://physics.nyu.edu/faculty/sokal/transgress_v2/node2.html#:~:text=In%20Hermann%20Minkowski%27s%20famous%20words%20%281908%29%3A%20Henceforth%20space [Accessed 7 Apr. 2024].

Tolentino, C. (2023). Who Invented Gravity? History Behind the Theory of Gravity | History Cooperative. [online] History Cooperative. Available at: https://historycooperative.org/who-invented-gravity/.

Urone, P.P.U. and Hinrichs, R.H. (2020). Physics. [online] openstax.org. OpenStax. Available at: https://openstax.org/books/physics/pages/1-introduction.

Westfall, R.S. (2019). Isaac Newton - Career. In: Encyclopædia Britannica. [online] Available at: https://www.britannica.com/biography/Isaac-Newton/Career.

Yasir, M. (2022). Basic Mechanics: Gravity and Newton's Law of Gravitation. [online] Owlcation.

LIFE SCIENCE
LEAD EDITOR: JASMINE CAMPION

REFERENCES

The Science of Love and how it has changed over time By Fletcher Bradford-Parnell

(1) Betterhelp (2024). Love in Greek: Classical ideas of Love and Romance. Available at: https://www.betterhelp.com/advice/love/love-in-greek-classical-ideas-of-love-and-romance/

(2) Han, Y., Luo, Y., Chen, Z. et al (2024). A decade of love: mapping the landscape of romantic love research through bibliometric analysis. Available at: https://www.nature.com/articles/s41599-024-02665-7#Sec6

(3) Dr Nina Mikirova (2019). The Research on Love: A Psychological, Scientific Perspective on Love. Available at: https://riordanclinic.org/2017/01/research-love-psychological-scientific-perspective-love/

(4) William Cole (2022). Biochemistry Of Love: Meet The Hormones and Neurotransmitters That Rule Your Feelings. Available at: https://www.mindbodygreen.com/articles/what-happens-to-your-hormones-when-youre-in-love

Darwin's Theory of Evolution and the work of Watson and Crick - The Structure of DNA By Emaan Mahmood

(1) "Encyclopedia Britannica." YouTube: Home, 9 November 2017, https://www.britannica.com/one-good%20fact/what-peculiar-culinary-habit-did-charles-darwin%20have. Accessed 23 March 2024.

(2) Winston, R. The information age. pp.284-285 ed., London, DK, 2013.

(3) Ibid.

(4) Winston, Robert. Sciene Year By Year. pp. 204-207 ed., London, DK, 2013.

(5) "The World Before Darwin." YouTube: Home, American Museum of Natural History, 9 November 2017, https://www.amnh.org/exhibitions/darwin/the-world-before%20darwin. Accessed 2 March 2024.

MEDICINE
LEAD EDITOR: KAYAN RANINA

REFERENCES

Özti the Iceman and a Prehistoric Outlook on Medicine By Josh Obi

- www.joh.cam.ac.uk. (n.d.). **Vesalius & the Study of Anatomy | StJohns.** [online] Available at: https://www.joh.cam.ac.uk/library/vesalius-study-anatomy.

- **Harvard Library (2022)**. Germ Theory. [online] Contagion - CURIOSity Digital Collections. Available at: https://curiosity.lib.harvard.edu/contagion/feature/germ-theory.

- **Kutschera, W. (n.d.)**. 4.4 Radiocarbon dating of the Iceman Ötzi with accelerator mass spectrometry. [online] Available at: https://www2.chemistry.msu.edu/courses/cem485/lectures/icemanage.pdf.

- **Karydi, C., García-Donas, J.G., Tsiminikaki, K., Bonicelli, A., Moraitis, K. and Kranioti, E.F. (2022)**. Estimation of Age-at-Death Using Cortical Bone Histomorphometry of the Rib and Femur: A

- **Validation Study on a British Population**. Biology, 11(11), p.1615. doi:https://doi.org/10.3390/biology11111615.

- **University of Toronto News. (n.d.).** U of T researchers find that ancient Iceman's infection helps Lyme disease bone loss discovery. [online] Available at: https://www.utoronto.ca/news/u-t-researchers-find-ancient-iceman-s-infection-helps-lyme-disease-bone-loss-discovery#:~:text=Named%20after%20the%20%C3%96tzal%20Alps

- **Peintner, U., Pöder, R. and Pümpel, T. (1998)**. The iceman's fungi. Mycological Research, 102(10), pp.1153–1162. doi:https://doi.org/10.1017/s0953756298006546.

- **Meilan Solly (2018).** What Ötzi the Iceman's Tattoos Reveal About Copper Age Medical Practices. [online] Smithsonian. Available at: https://www.smithsonianmag.com/smart-news/what-otzi-icemans-tattoos-reveal-about-copper-age-medical-practices-180970244/.

The history of reproductive medicine during the Nazi era By Garshana Ramanathasan

- **Teicher, A. (2019).** Why Did the Nazis Sterilize the Blind? Genetics and the Shaping of the Sterilization Law of 1933. Central European History, 52(02), pp.289–309. doi:https://doi.org/10.1017/s000893891900030x.

- **Thompson, L.V. (1971).** Lebensborn and the Eugenics Policy of the Reichsführer-SS. Central European History, 4(1), pp.54–77. doi:https://doi.org/10.1017/s0008938900000443.

History of Surgery – Meshayel Shah

Amr, S.S. and Tbakhi, A. (2007). Abu Al Qasim Al Zahrawi (Albucasis): Pioneer of Modern Surgery. Annals of Saudi Medicine, [online] 27(3), pp.220–221. doi:https://doi.org/10.5144/0256-4947.2007.220.

- **Clunie, A. (2014)**. History of Surgery | Hartford Stage. [online] Hartford Stage. Available at: https://www.hartfordstage.org/stagenotes/ether-dome/history-of-surgery.

- **Douglas James Guthrie and Archibald, W. (2017)**. History of medicine - Traditional medicine and surgery in Asia. In: Encyclopædia Britannica. [online] Available at: https://www.britannica.com/science/history-of-medicine/Traditional-medicine-and-surgery-in-Asia.

- **Erjavic, N. (2018)**. Andreas Vesalius (1514–1564) | The Embryo Project Encyclopedia. [online] embryo.asu.edu. Available at: https://embryo.asu.edu/pages/andreas-vesalius-1514-1564#:~:text=Vesalius%20was%20one%20of%20the.

- **McKellar, S. (2010)**. A history of surgery: From superstition to science. Canadian Medical Association Journal, 182(8), pp.809–809. doi:https://doi.org/10.1503/cmaj.100436.

- **Payne, T., Toms, J.D., Zaidi, A. and Thrumurthy, S.G. (2021)**. The history of surgery and surgical training in the UK. Pakistan Journal of Medical Sciences, 37(5). doi:https://doi.org/10.12669/pjms.37.5.4628.

- **Pitt, D. and Aubin, J.-M. (2012)**. Joseph Lister: father of modern surgery. Canadian Journal of Surgery, [online] 55(5), pp.E8–E9. doi:https://doi.org/10.1503/cjs.007112.

- **sitecore\hshaw@rcseng.ac.uk (2009)**. History of Women in Surgery — Royal College of Surgeons. [online] Royal College of Surgeons. Available at: https://www.rcseng.ac.uk/careers-in-surgery/women-in-surgery/history/.

- **The Editors of Encyclopedia Britannica (2019).** surgery | Definition, History, Type, & Techniques. In: Encyclopædia Britannica. [online] Available at: https://www.britannica.com/science/surgery-medicine.

- **Whitlock, J. (2011)**. The Evolution of Surgery: A Historical Timeline. [online] Verywell Health. Available at: https://www.verywellhealth.com/the-history-of-surgery-timeline-3157332.