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- Health for Heroes

Health for Heroes

Prior to the early 20th Century the majority of casualties were not due to hostilities but suffering illness or death from disease often as the result of poor hygiene or debilitating parasitic infestation. As each of these were conquered the efforts turned to the combating the effects of blood loss.

Edmund Alexander Parkes (1819 - 1876)

As the incompetence of the medical services in the Crimea became common knowledge, EA Parkes was appointed to take charge of a temporary hospital at Renkioi in the Dardanelles to relieve pressure on the hospitals in Scutari.

Prevalent Diseases

- Typhoid
- Syphilis
- Yellow Fever
- Tuberculosis
- Malaria
- Undulant Fever
- Kala-azar
- Sleeping sickness

No Aseptic Technique

Joseph Lister had not yet popularised the use of antiseptics in surgery.

- Doctors ignored the cleanliness of their surgical instruments and wounds became infected during surgery.

Crimean War 1854-1856

- Within a few weeks of the British Army's arrival in the Crimea, around 8,000 soldiers had contracted cholera or malaria
- The swift spread of disease amongst wounded soldiers was mainly due to insanitary conditions in the hospitals
- Most lacked effective sewerage and ventilation
- Severe overcrowding
- Many more soldiers died from cholera and dysentery than battle wounds

1858 Royal Sanitary Commission

As a result of the glaring faults of organisation in the Army Medical Department, a Royal Commission was convened.

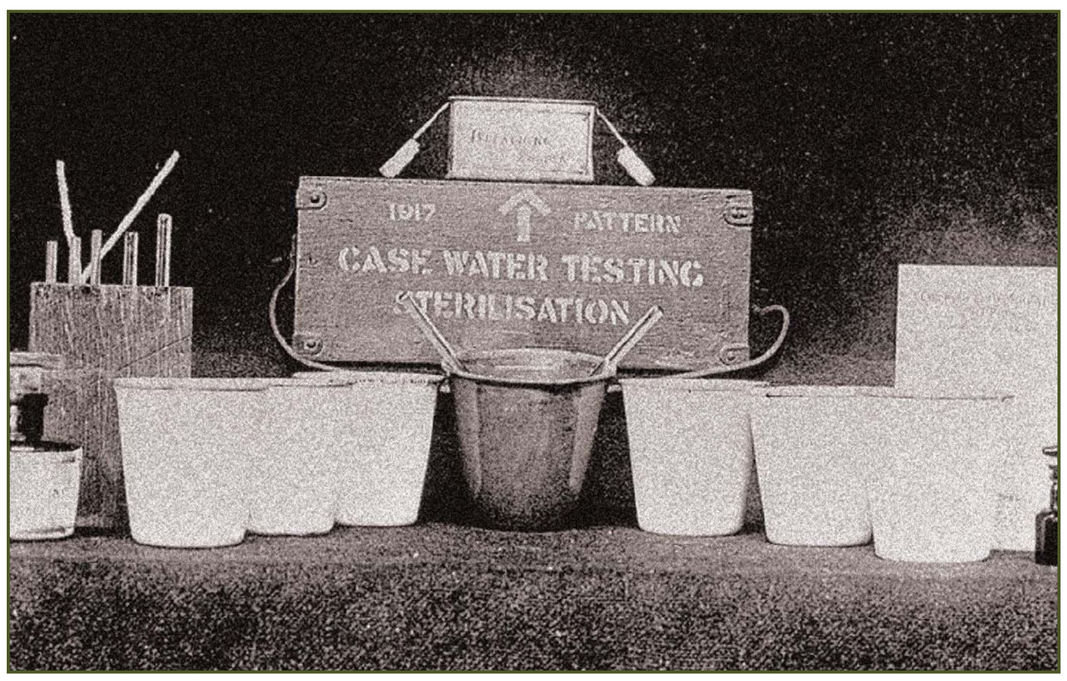
- Parkes served on the Commission, which included Florence Nightingale, to investigate the health of troops
- The establishment of a Army Medical School with a brief to instruct young Medical Officers in medicine, surgery, hygiene and sanitary science
- The first Army Medical School was set up at Fort Pitt in Kent
- Parkes became the first Professor of Military Hygiene
- After three years the Army Medical School moved to the 1000 bedded Royal Victoria Hospital at Netley near Southampton Water
- 1863, Parkes produced his Manual of Practical Hygiene which was to run to eight editions 1864 –1891

After The Crimean War

The Royal Commission highlighted issues that needed to be addressed: the commission ordered that sanitary experts should report on the suitability of proposed sites for Army hospitals and barracks: more suitable sanitation facilities should be supplied (e.g. properly dug sewers). The inadequate provision of medical transport which was run by veterans of previous campaigns. Many of these veterans were in ill health and consequently helped to spread infections such as cholera. Soldiers' exposure to extreme cold resulted in ill health. The commission ordered the provision of suitable uniforms for different climates.

South African War 1899-1902

The main killer in the war was again not the enemy but disease; 6,000 British soldiers were killed in action whilst 14,000 died of disease (8,000 from Typhoid: 74,000 were treated). The advice of the new Hygiene Officers was ignored, resulting in poor sanitation and drinking water. One problem was the long evacuation chain for casualties. Each soldier carried a field dressing which he was to apply to himself if wounded.



Lesson From The South African War

The high number of deaths due to disease highlighted the need for strict hygiene procedures to be introduced into the hospitals. Sir Almroth Wright and Captain Leishman (who later became Director General of the Army Medical Services) started work on an anti-typhoid vaccine. Resultant vaccination of 10 million troops in WW1 largely eliminated typhoid casualties.

Pure Drinking Water

Colonel William Horrocks RAMC developed the Horrocks Box. This device filtered water through sand in order to provide a portable method of purifying drinking water. It was particularly beneficial during WW1 in keeping Allied forces largely free from water borne diseases. Dr (Later Colonel) Sims Woodhead introduced chlorination of water in bowsers and devised a test for residual chlorine in the water. Its success laid the foundations for continuous water treatment until this day.

Health & Fitness Of Recruits

- Of great concern at induction was the general bad health of the nation
- Recruits were already weakened by poor nutrition, tuberculosis or typhoid and were susceptible to further disease
- High priority given to raising the nutrition and the fitness of civilian population to provide suitably fit men to defend the expanding empire and fight future wars

Antibacterial revolution

- In the decade from 1935-1945, a new class of medicines capable of controlling bacterial infections launched a therapeutic revolution that continues today. It began in the mid-1930's with the use of sulphonamides
- Penicillin was first used to great effect in the North Africa campaign
- Both carried the main therapeutic burden in both military and civilian medicine

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Major Lawrence Bruce Robertson

The man who introduced a new syringe-cannula technique, which allowed direct donor to patient transfusion.

Effective Blood Transfusion

Throughout the 20th century, milestones in the advancement of blood transfusion were synchronised with the onset of military conflict around the world. Beginning with the new knowledge of matching different blood groups and the use of an anticoagulant that facilitated indirect transfusion.

Prior to the First World War

In 1901 Landsteiner discovered the ABO blood groups. Transfusion was only possible using defibrinated blood. In 1914 Moss instigated direct donor to patient techniques, using paraffin wax coated tubing and bottles. This was always dependent on a ready supply of donors close to the battlefield.

Anticoagulants Facilitated Indirect Transfusion

In Belgium in 1914 Adolph Huston demonstrated that Sodium citrate, in tolerable quantities, could anticoagulate blood for transfusion. the following year Luis Agote in Argentina and Richard Lewisjohn in the USA, verified its use for this purpose.

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Blood Transfusion

Outbreak of World War l

Between 1916 –1917 Canadian Army Major Lawrence Bruce Robertson, introduced a new syringe-cannula technique for performing direct donor to patient transfusion of unmatched blood saving the lives of many casualties.

Blood transfusion was favoured by the American and the Canadian surgeons arriving at the Western Front. Capt. Oswald H. Robertson MORC USA in 1918 established the first bank of stored whole blood. Blood that tested negative for syphilis, could be given quickly and safely in forward medical units.

The beneficial effect in combating blood loss in major trauma was soon recognised and adopted by British and French surgeons.

The Spanish Civil War 1937-1939

Gave rise to a fresh approach to blood transfusion, hastened by the threat of large numbers of civilian and military casualties. With a major initiative to increase the number of blood donors and to establish large-scale blood banks to ensure supplies.

Canadian Norman Bethune, whose WW1 experience taught him the importance of helping the wounded quickly. He set up a blood bank close to the front lines and organised a mobile blood-transfusion service, the first of its kind.

Jorda added glucose to the citrate anticoagulant for blood collection improving the viability of transfused red cells which increased the benefits of transfusion.

The subsequent publication of the effectiveness of transfusion, by army surgeons, resulted in its introduction to civilian medical practice.

Onset of World War ll

Prior organisation was haphazard in UK with a few exceptions e.g. Lane in London. 1938 the War Department decided how blood transfusion support would be provided to military hospitals in war. 1939 established of the Army Blood Transfusion Service and opened the Army Blood Supply Depot (ABSD) Commanded by Colonel LEH Whitby l/RAMC, the first military transfusion service in the world.

Whitby recognised that blood is a perishable commodity, as potentially lethal as it is life saving and had to be handled through special channels by competent trained personnel.

Acid Citrate Dextrose (ACD) Solution

This was introduced in 1943 by J.F. Loutit and Patrick L. Mollison. It reduced the volume of anticoagulant, allowing greater volume of blood to be given and permitting longer term storage.

ABTS Organisation

The Army Blood Transfusion Service was organised on three levels:

- The ABSD, producing all wet and dried products, crystalloids, grouping sera, blood collecting and administering blood equipment. Provided training in all areas
- Base Transfusion Units, which were chiefly concerned with distribution. In each theatre of operations, five were deployed
- Field Transfusion Units, which worked in forward areas

Freeze Dried Plasma

Early years research at the Lister Institute UK developed techniques for storage of plasma for transfusion, stable in hot climates.

- A massive demand for plasma supplies to treat military and civilian casualties
- Freeze-drying plants were established at the ABSD
- 1944, Edwin Cohn described the ethanol separation and purification of plasma

The War Legacy

During the period September 1939 to May 1945 the Plasma and Blood Bank balance was 756,046 units. Due to the care and competence with which the British handled blood

- Accidents where kept to a minimum
- No single case of incorrectly typed blood recorded

Led to the establishment of the National Blood Transfusion Service in all regions plus Plasma Product plants at Elstree and Chelsea.

Late 50's Introduction of Plastics

- Avoidance of breakage and waste
- Integral blood taking set
- Disposable blood giving sets
- Start of safe component production

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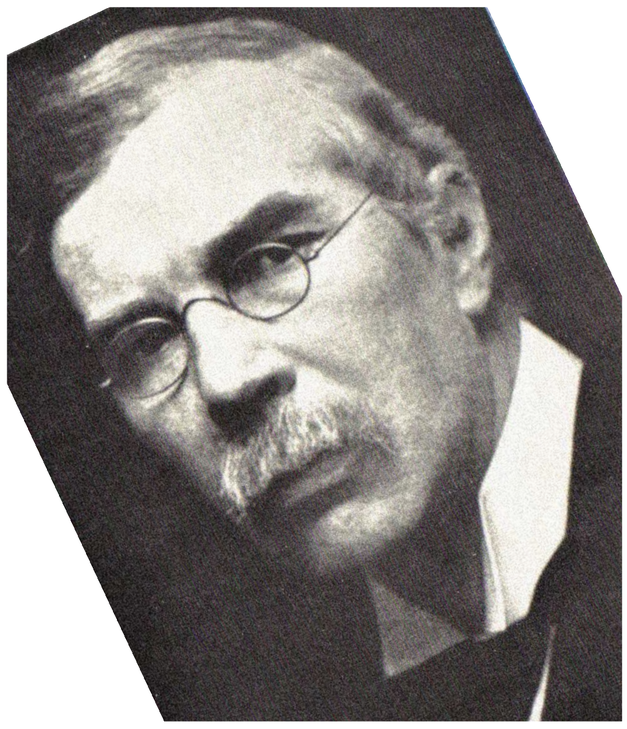
Typhoid Vaccine



Sir Almroth Edward Wright (1861-1947)

Britain's first Academic Immunologist
A pioneer of Medical Laboratory Science

He was qualified in both Modern Languages and Medicine and commenced his professional life as a Physiologist. After working in Europe and Australia he returned to London. In 1889 he worked at the conjunct research laboratories of the Royal College of Physicians and Surgeons where his supervisor Dr German Sims Woodhead, then advisor on Pathology to the British Army, recommended him to the post of Professor of Pathology at the Royal Army Medical College based at Netley. He was appointed in 1892 as a civilian which led to some conflict with the other candidate David Bruce, a serving Officer who was appointed Assistant Professor.

An opinionated man, often aggressive when propounding his views and not always right, hence his nick-name "Sir Almost Right".

Typhoid Inoculation

- Still convinced of the value of anti-typhoid vaccine Wright started a production unit in partnership with Parke Davies and arranged for a second study on British troops stationed in India. The promising results were ignored by the army
- 1914 on the eve of war, Wright appealed to the War Office to inoculate troops against typhoid and petitioned Lord Kitchener who agreed and ordered a mandatory inoculation programme
- Thanks to 10 million vaccine doses produced at St. Mary's Britain was the sole combatant with troops immunised against typhoid at the start of World War 1

Laboratory Instruments

During this period laboratory instruments were generally crude and home-made, so Wright - a pioneer in laboratory testing - made his own, developing and producing capillary tubes large enough to hold only a few drops of blood. With these instruments he could test blood without the necessity of drawing a great deal of it from a patient; all that was required was a finger prick. Wright also recognized the importance of uniformity in laboratory testing, so he made sure each tube was identical.

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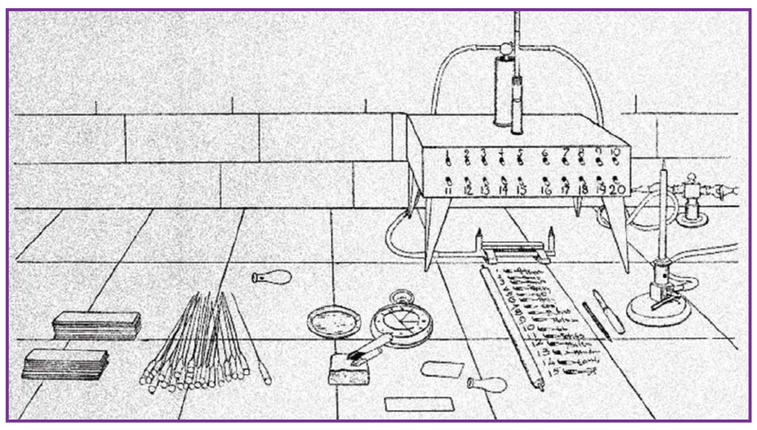
- At the RAMC Netley he began his life's work on immunity
- Typhoid Fever had a death rate of 10-30% at that time
- 1884 Gruber, Pfeiffer, Kolle & Widal had shown that patients who recovered from typhoid had antibodies in their serum which agglutinated the typhoid bacteria in vitro. The Widal Test was born
- He tested the effect of injection with heat killed typhoid culture first on himself and co-worker Semple, then on 15 soldiers
- He produced antibodies and immunity to typhoid
- Despite bad side effects he then inoculated 2835 British soldiers going to India where typhoid was common. It appeared very few developed the disease
- 1899 the War office agreed to inoculate soldiers heading for the Boer War but limiting it to volunteers only. Of the 448,000 dispatched only 14,000 were inoculated, anecdotal evidence showed its worth where only half of the inoculated men developed the disease, however record keeping during the war was poor. Wright had a deep aversion to statistics
- This was seized upon by the leading biological mathematician of the time, Karl Pearson, who said the data showed nothing
- The War Office set up an inquiry which included David Bruce. It later sided with Pearson and judged the vaccine ineffective and the programme was suspended
- Incensed by this,Wright resigned his post at Netley. Leishman, who was appointed as his successor, continued the work, modified the production method and improved the inoculum
- 1902 Wright moved on to St Mary's Hospital Medical School as Professor of Pathology and set up a vaccine and inoculation clinic

1912 published "Technique of the Teat and Capillary Glass Tube". He demonstrated the opsonic effects of serum, the principle of antibody inoculation in bactericidal infections, the bacterial efficiency of the whole blood and phagocytes and the influence of the antitryptic power of the serum on the growth of microbes. His team consisted of Freeman , Colebrook, Mathews, Fleming and others.



The Maidstone Typhoid Outbreak of 1897

- The first coordinated approach to control. This was the largest outbreak of typhoid fever ever reported in the United Kingdom. It began September 1897 and ended in January 1898 affecting nearly 2000 people, 143 of whom died. At its peak 900 people contracted the disease in a two week period. The cause was traced to contaminated mains water and its continuing spread was linked to the poor state of the drainage system and the housing of many of the victims
- It was a turning point in public health, featuring the first recorded trial of immunisation against typhoid and also disinfection of a mains water supply, using chloride of lime
- The typhoid immunisation trial was led by Professor Almoth Wright. Staff at a large psychiatric hospital near Maidstone were asked to volunteer for the trial. None of the 84 who received the new vaccine developed the disease, compared with four cases in the 120 who were not vaccinated. This established the vaccine's potential value and led to larger trials
- The chlorination of the water supply, organised by the bacteriologist Dr Sims Woodhead, was a difficult procedure that required several attempts. Its success laid the foundations for continuous water treatment. The Maidstone outbreak may also have been the first in which telephones were used in the control of an epidemic, allowing doctors and nurses in the emergency hospitals to pass on information about cases

1914 – 1918 Wright was appointed a consultant physician to the Army with the rank of Colonel RAMC. Dispatched to France to set up a research laboratory attached to a hospital in Boulogne. To investigate the new problems of gunshot wound infection, gas gangrene and shock. He was assisted at varying times by his team from St Marys Hospital.

A Different Kind of Battlefield

- Flanders Fields were cultivated, well manured and horses were in common use around the battlefields. Soldiers living in the trenches became contaminated with mud containing faecal bacteria and bacterial spores
- Projectile wounds caused by bombs, shell fragments and high velocity bullets carried in filthy mud and fragments of soldiers clothing
- Most damage was caused by Clostridium perfringens synonym C. welchii causing gas gangrene and Chlostridium tetani causing tetanus

Treatment of War Wounds

Established thinking was based on the experience in the South African War. The land was bare and dry containing few pathogens. Projectile wounds were mainly from bullets fired from a distance often passing through limbs and often healed quickly without complication. This together with accident ward experience in civil hospitals led to the treatment of wounds with antiseptic solution. This Listerian tradition was blindly followed by military surgeons.

With Alexander Fleming he showed that these antiseptics killed the macrophages and neutrophils that were gathering at the wound, and prevented healing; furthermore, the use of antiseptic paste encouraged the growth of anaerobes, with the fatal production of tetanus or gas gangrene. Wright's (successful) approach was to clean the wound with sterile hypertonic saline and suture it secondarily.

Therapeutic Methods

Wright proposed three distinct therapeutic measures when dealing with wounds (1915 University of London Press)

- Treatment by antiseptics.
- Treatment by physiological methods such as opening and draining the wound to bring the antibacterial powers of blood to bear on the infecting microbes. Cutting out damaged and infected tissue. Applying hot fermentations (poultices) to induce active hyperaemia and increasing the outflow of lymph and lymphocytes. Leaving operation wounds un-sutured.
- Treatment by vaccine therapy.

Tetanus Antiserum

1899 Behring & Kitasako demonstrated that serum from another animal immune to a disease such as tetanus could be used to treat other animals (including humans) with the disease.

- Produces antitoxins that could by used to treat others effectively
- An antitoxin was developed for tetanus and diphtheria in 1890

What would have happened without Wright's Passion?

It took two or three years to overcome the old dogmas, by which time millions more lives had been lost. Would this have been achieved at all without Wright's passion and abrasiveness?

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Tropical Diseases

Walter Reed
(1851-1902)

After the Spanish-American War the Walter Reed Commission set up in Cuba

A series of experiments was conducted to explore how yellow fever is transferred from individual to individual and how the disease is spread within households.

The study was conducted in an experimental sanitary station in Cuba, where exposures and movements could be completely controlled. During the investigation, 12 non-immune persons underwent different exposures, including mosquitoes that had fed on yellow fever patients, blood from infected patients, and fomites belonging to infected patients.

Observations Found:

Aedes aegypti mosquitoes transferred the disease from an infected individual to a non-immune person proving Carlos Finlay's Mosquito Hypothesis . At least 12 days were needed for the extrinsic incubation period in the mosquito before it could transmit the infection. Yellow fever can be transferred to a nonimmune person from the blood of an infected individual taken during the first two days of the illness.
A filterable agent was responsible for infection. The incubation period for humans ranged between two and six days and yellow fever cannot be transmitted by fomites nor spread in a house without the presence of mosquitoes. The most significant conclusion was that the spread of yellow fever can be most effectually controlled by measures directed to the destruction of mosquitoes.

Walter Reed later served on the typhoid commission.

Quinine

The bark of the cinchona tree is the only known natural source of quinine. The medicinal properties of the cinchona tree were originally discovered by the Quechua Indians of Peru and Bolivia; later, the Jesuits were the first to bring the cinchona to Europe. Quinine was the first effective treatment for malaria caused by Plasmodium falciparum, appearing in therapeutics in the 17th century. It remained the antimalarial drug of choice until the 1940s, when other synthetic drugs replaced it. Since then, many effective antimalarials have been introduced, although quinine is still used to treat the disease in certain critical situations.

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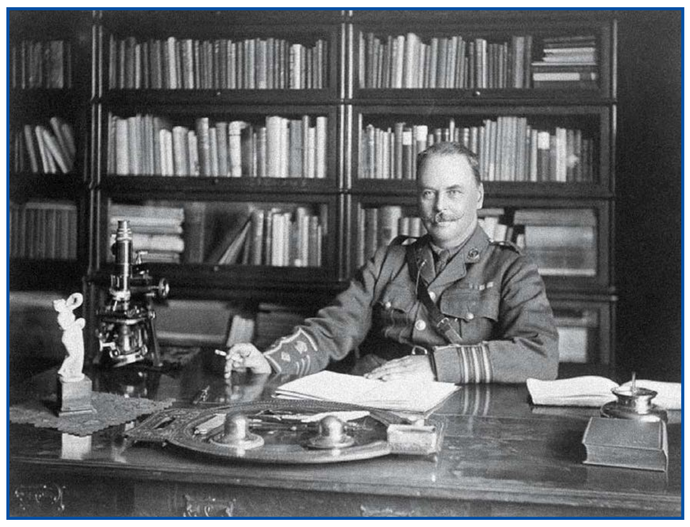
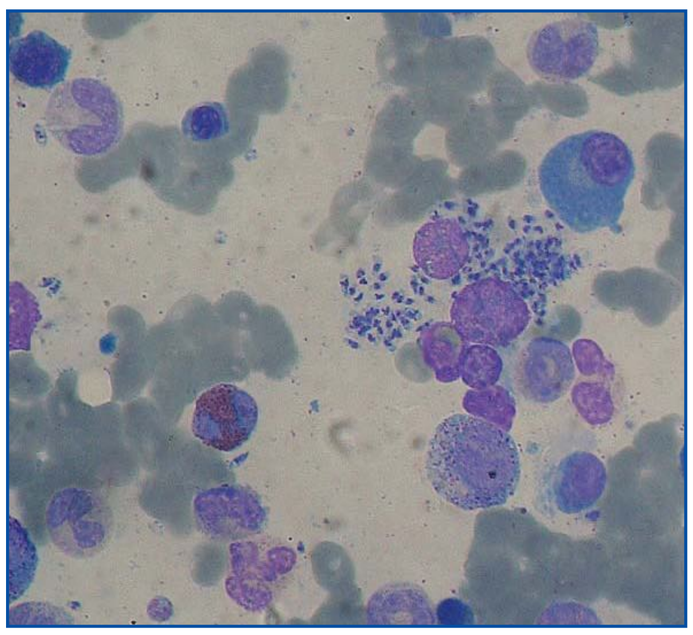


Sir Ronald Ross
(1857-1932)

Malaria life cycle, Nobel Laureate

Graduated from St Bartholomew's Hospital Medical School 1881 and joined the Madras branch of the Indian Medical Service (IMS). He studied malaria between 1881 and 1899 at the Presidency General Hospital, Calcutta. In 1883, Ross was posted as the Acting Garrison Surgeon at Bangalore during which time he noticed the possibility of controlling mosquitoes by controlling their access to water. In 1897, Ross was posted in Ooty and fell ill with malaria. He was then transferred to Secunderabad, where the Osmania University Medical School is located. He discovered the presence of the malarial parasite within the Anopheles mosquito and went on to trace the means of transmission avian malaria.

In1899 he resigned from the IMS and joined the infant Liverpool School of Tropical Medicine. In Sierra Leone he completed his work on the transmission of human malaria. He was called up in 1914. As well as being consultant physician to Indian troops stationed in England he went to Egypt to investigate dysentery, ending the war working for the War Office on the co-ordination of the treatment of men with malaria.



Leishman-donovan bodies - spleen smear Leishman stain

Each year there are, according to the World Health Organisation, more than 225 million cases of malaria worldwide. The majority of deaths are of young children in sub-Saharan Africa. Altogether 90% of the malaria related deaths occur in this region. Malaria is commonly associated with poverty and can indeed be its cause which in turn is a major hindrance to economic development.

Lieutenant-General Sir William Boog Leishman
(1865-1926)

Leishman Stain, Leishmaniasis

- Director-General of Army Medical Services from 1923 to 1926
- Leishman also helped elucidate the life cycle of Spirochaeta duttoni, which causes African tick fever
- In 1900 he became Assistant Professor of Pathology in the Royal Army Medical College
- Described a method of staining blood for malaria and other parasites- a modification and simplification of the existing Romanowsky method using a compound of Methylene Blue and Eosin dissolved in methanol. This became known as Leishman's stain and is still in use today and is endorsed by the WHO
- With Almroth Wright, he helped develop an effective anti-typhoid vaccine. Later, between 1904 and 1909, he tested and improved the vaccine, leading to its widespread use
- In 1901, Leishman identified oval bodies in smears taken from the spleen of a patient who had died from "dum-dum fever" found for the first time in India

- Captain Charles Donovan working independently confirmed the finding of what became known as Leishman-Donovan bodies in smears taken from patients in Madras, India
- Ross proposed that Leishman-Donovan bodies were the intracellular stages of a new parasite, which he named Leishmania donovani. He was first to suggest the link with the disease Kala-azar, this was confirmed by Charles Bentley's discovery of Leishmania donovani in patients with Kala-azar.
- The disease was a major problem for Allied troops fighting in Sicily during the Second World War

What is Leishmaniasis?

Leishmaniasis is found ranging from rainforests in Central and South America to deserts in West Asia and the Middle East. It affects as many as 12 million people worldwide, with 1.5–2 million new cases each year. The visceral form of Leishmaniasis has an estimated incidence of 500,000 new cases and 60,000 deaths each year, more than 90 percent of the world's cases of are in India, Bangladesh, Nepal, Sudan, and Brazil

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Major General Sir David Bruce

(1855-1931)

David Bruce was well known for his study of Malta fever (brucellosis) and sleeping sickness (trypanosomiasis).

Born in Australia and moved to Scotland aged 5 when his family returned home. He graduated from Edinburgh Medical School. He was a great physician and a pioneer of veterinary microbiology.

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Malta Fever

Malta fever

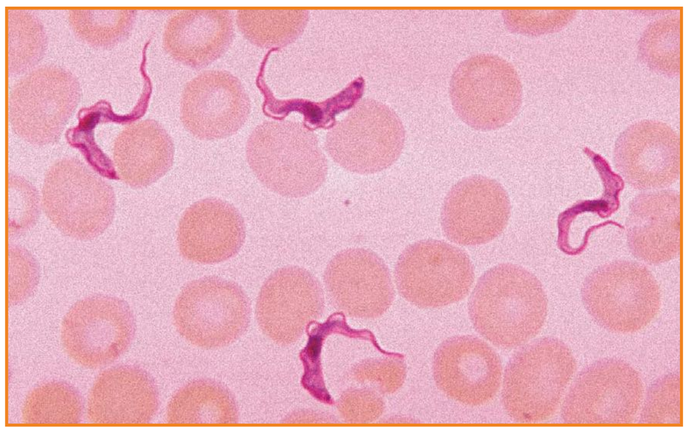
- After a brief spell in general practice, Bruce started his military medical career by entering the Army Medical School at Netley, passing out top of the list in 1883, and in August that year was commissioned Surgeon Captain in the Army Medical Service
- The following year he was posted to Valetta Hospital, Malta, which had no research facilities. Bruce provided his own microscope and equipment
- Impressed by Robert Koch's recent discovery of the tubercle bacillus, Bruce decided to investigate Malta fever, which annually hospitalised around a hundred soldiers of the British garrison for an average of three months. Malta fever was responsible for 120,000 days of disease each year
- Following Koch's postulates he identified Micrococcus (Brucella) melitensis (1887) as the aetiological agent of brucellosis in humans and cattle
- In 1905 Bruce headed the Commission for the Investigation of Mediterranean Fever where T. Zammit, one of the Maltese members, found that goat's milk was the disseminating vehicle
- When goat's milk was eliminated from the diet of the Malta garrison, the disease disappeared. This disease is now called brucellosis. The names "Malta fever" or other names such as "Mediterranean fever" or "undulant fever" are no longer used

Laboratory at night - Major General Sir David Bruce

Into Africa

- 1894 Bruce was posted to Natal at the request of the Governor, Sir Walter Hely Hutchison, a former Lieutenant Governor of Malta. Hutchison asked him to investigate an epizootic disease, Nagana that was afflicting cattle in northern Zululand
- Captain and Mrs. Bruce sailed for Pietermaritzburg, continuing the long journey to Umbumbo by ox cart, in much the same way as David Livingstone had some 40 years previously
- After trekking for five weeks, the Bruces arrived at Ubombo, where they lived for two months in a wattle-and-daub hut, using the veranda as a laboratory
- Nagana, a devastating disease, was killing large numbers of the Zulu's cattle
- This had serious implications, as the cattle were essential to their welfare and way of life
- A similar disease known as Surra had been described in West Africa
- Also in India, a disease had been described that attacked horses, asses, mules, and camels
- In 1877 a surgeon, Timothy Lewis of the Royal Army Medical Corps, discovered a trypanosome in a rat whilst working in Bombay

Captain Bruce proved that a Trypanosoma brucei was the agent causing Nagana in cattle and sleeping sickness in humans and tsetse fly Glossina morsitans was the vector transmitting the disease (1895).



Back to Africa

Captain David and Mary Bruce returned to South Africa to investigate the outbreak of enteric fever during the Boer War. They were present at the siege of Ladysmith where he commanded a Field Hospital. He returned home 1901.

And Again

- 1908, Bruce rejoined the commission. 1911, appointed Director of the third commission and went to Nyasaland, Trypanosoma gambiense and the tsetse fly Glossina palpalis being implicated

Again

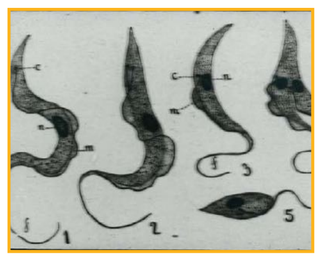
- 1903 He was appointed head of the Royal Societies Sleeping Sickness Commission to Ugand. His team consisted initially Dr David Nunes Nabarro and a Sergeant Technician
- Dr A Castellani the remaining member of the first commission demonstrated trypanosomes in the cerebrospinal fluid of 25 victims before leaving. He taught Bruce the techniques for lumbar puncture and specimen examination. Trypanosoma gambiense and the tsetse fly Glossina palpalis the vector
- Left for Malta in 1904

Current Nomenclature

Trypanosoma gambiense found in the West Africa

Trypanosoma rhodesiense found in East Africa

Trypanosoma brucei found in Zululand, causing Nagana



What is Trypanosomiasis?

Human African trypanosomiasis, sleeping sickness, African lethargy or Congo trypanosomiasis It is estimated that 50,000 to 70,000 people are currently infected, the number having declined somewhat in recent years. Four major epidemics have occurred in recent history: one from 1896–1906 primarily in Uganda and the Congo Basin. There were under 10,000 cases reported in 2009 according to WHO figures which represents a huge decrease from the estimated 300,000 new cases in 1998. The disease has been recorded as occurring in 36 countries, all in sub-Saharan Africa. It is endemic in south east Uganda and western Kenya, and killed more than 48,000 Africans in 2008.