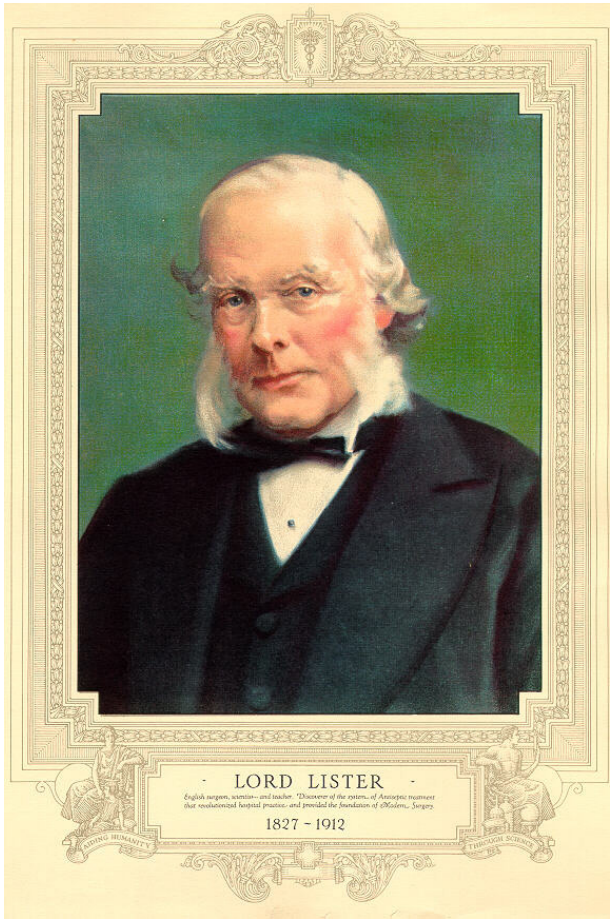
Joseph Lister (1827 – 1912)



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If post-surgery survival were the criterion, the history of surgery can be divided into two periods. The one before and the one after Lister. In the pre-Lister era, around 40% of operated patients died of wound infection or sepsis. By the year 1910, this proportion had gone down to just 3%.

Pre-Lister

In the beginning of the 19th century, surgery was still very much at the same level as two centuries earlier, in the days of Ambroise Paré. There was no anesthesia and no antisepsis. Typically, "the operation was a success, but the patient died." In those pre-Lister days, a successful surgeon was someone who could perform surgery at lightning speed, was immune for the deafening clamor of his patients and undisturbed by a 40% postoperative mortality rate of his clientele. An example of such a surgeon was Robert Liston, who could amputate a lower leg in exactly 28 seconds. The faster, the better, as exposure of the wound to air (oxygen) was directly related to the chance of wound infection. Or

at least, this was the common believe at the time. The culprit was not known but its deadly effect had a name: hospitalism. A sad term for dying postoperatively of suppuration, sepsis, puerperal fever and the much-feared hospital gangrene. Patients shoved into theatre in those days were more likely to die than French soldiers on the battlefields of Waterloo.

Heroic times

Joseph Lister was about to change all that. Not on his own, because great discoveries never arise from thin air. As Isaac Newton noted: "If I have seen further, it is by standing on the shoulders of Giants." Lister's shoulders were those of Louis Pasteur. Another characteristic of great discoveries is that they are often not valued immediately. The initial skepticism and controversy surrounding these ideas ensures that, even in the best case scenario, penetration into the minds and daily practice is slow. To name just one of such objections to Lister's achievements: if the patients is anesthetized (and thus no longer screaming in anguish) and the air is germ-free, speed is no longer of the essence. So long to the image of the heroic surgeon who measured his success on his operating speed! Instead of 28 seconds, Lister's procedures take half an hour, but his patients do survive…

Inner light

Joseph Lister is born on April 5th, 1827, in Upton, Essex, England. Father Jackson Lister is a prosperous wine dealer with an unusual hobby. He builds and improves microscopes. By applying the physical law of aplanatic focal points, he solves the 150-year old problem of chromatic aberration. For this feat, he receives the Fellowship in the Royal Society in 1832.

Son Joseph is raised in the strict teachings of the "Religious Society of Friends", also known as the Quakers. It is a group of undogmatic disciples who are convinced that there is a little piece of God in every human being. A sort of inner light, that not only gives them a sense of inner peace, but also the strength to commit to those things they believe in. Not by shouting it from the rooftops, but by leading an exemplary life. This is what Lister will continue to do throughout his lifetime. With an impeccable serenity and boundless patience. For better or for worse.

Lady Agnes

Because no other school wanted to enroll Quakers, he commences his studies in the London University College. On December 2st, 1846, he witnesses the first surgery with the aid of ether anesthesia. The famous surgeon Robert Liston amputates the lower leg of butler Frederick Churchill painlessly, in exactly 28 seconds. Those who witnessed the procedure, said that the flickering of the knife moved into the sound of the saw so quickly, that it seemed as though both actions happened simultaneously.

After finishing his baccalaureate in Medicine in 1852, Lister is admitted to the Royal College of Surgeons. As the wine business of his father flourishes, Joseph is not in a hurry to look for a well-paid job. In 1853, he hauls to Scotland to see the most famous surgeon of his era at work, professor Sir James Syme from the University of Edinburgh. What was intended as a short stay, ends in an appointment as resident surgeon. The old Scottish surgeon and the young Lister immediately get along very well. So do Syme's daughter Agnes and Joseph… despite their religious differences, they get married, even though Joseph needs to convert to the Scottish Episcopal Church. Agnes Syme turns out be the very best type of wife a scientist can imagine. Not only does she offer him her domestic skills, she also becomes a dream secretary. She transcribes his dictates, assists him in his experiments and keeps his agenda. They will never have children.

Glasgow

In 1859, Lister applies for a vacant chair of surgery in Glasgow. After his appointment, he quickly realizes the ruinous conditions of the theatres. Too many patients die of the same complication: wound infection. He starts by implementing Florence Nightingale's most elementary hygienic principles. The floors, covered in dirt and mud, are thoroughly swept and the windows are opened. The towels and bed sheets are regularly washed. But the fresh air and hygienic measures do not amount to much. Unaware of the activities of Ingaz Semmelweis in Hungary, Lister asks himself the exact same questions. Why does a simple fracture heal easily, while a complicated, open fracture generally leads to infection and gangrene? Why is mortality so much higher in the hospital than when treated at home? What exactly is suppuration, and why does it occur? What is its cause?

Sour wine

Around that time, somewhere in France, Louis Pasteur is called by a couple of wine farmers. Their wine has turned into vinegar. An oenological disaster! Pasteur takes some samples of the wine, and under his microscope he sees numerous little organisms. Via Thomas Anderson, professor in Physiology in Glasgow, Lister hears of Pasteur's discovery. Alcoholic fermentation does not rely on magic, but on chemistry! Living organisms (yeasts)

seem to be responsible. Furthermore, acidification of wine (and putrefaction in general) is also caused by microscopically small organisms. Pasteur does not make the connection between these micro-organisms and festering wounds. He is a chemist after all, not a physician. But Lister does! He repeats Pasteur's experiments and discovers that in the suppuration of wounds as well, micro-organisms play a fundamental role. This becomes the basis of his antisepsis doctrine.

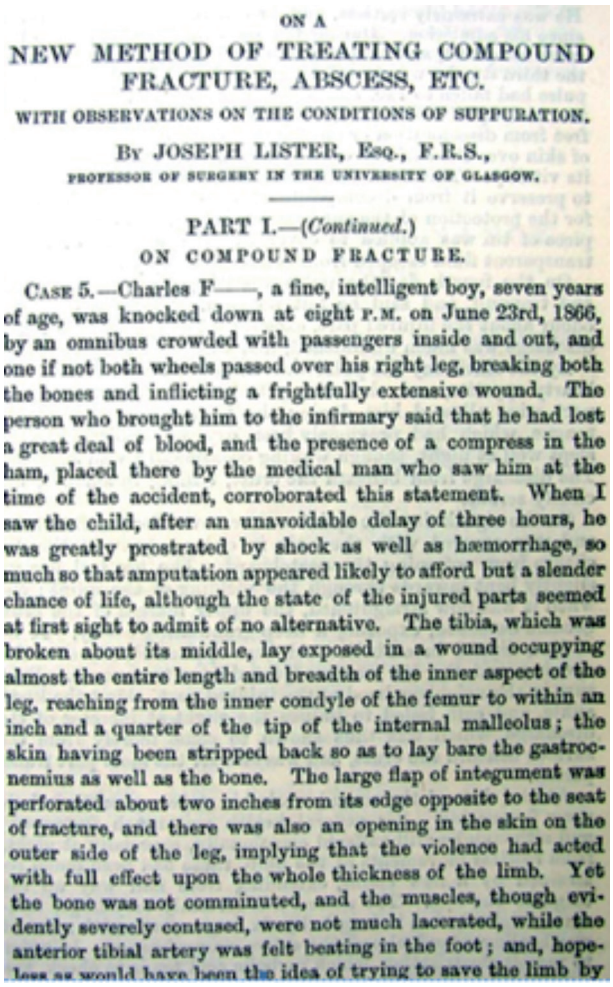
But how to kill these micro-organisms? Pasteur recommends three methods: filter them out, destroy them with heat (pasteurization) or kill them with an antiseptic agent. All well and good, but a patient is not a wine barrel or a milk jar. To filter organisms out of a wound is not an option. Burning out the purulent wound with boiling oil had also gone out of fashion since Ambroise Paré; too painful. This only leaves the last possibility. Lister writes in Lancet: "It appears that all that is requisite to dress the wound is with some material capable of killing these septic germs, provided that any substance can be found reliable for the purpose, yet not too potent as a caustic."

He is busy trying to find such a substance, which would kill the septic organisms without scorching the flesh, when it practically falls into his lap. In the little town of Carlisle, a putrid sewer stench had been controlled by using carbolic acid (phenol). For Lister, the connection between this stinking sewer water, the purulent bacteria which terrorize his patients and the carbolic acid which kills them, is easily made. He experiments with phenol on infected frog legs, and the results are remarkable. Now, it is just a matter of waiting for his first real patient!

James Greenlees

On August 12th, 1865, an eleven-year old boy, named James Greenlees, is brought into the Glasgow Royal Infirmary. He ended up under the wheels of a horse carriage and has a compound fracture as a result. Lister treats the wound with phenol and straightens the shinbone. The wound heals without suppuration, and six weeks later the boy leaves the hospital with a perfectly healed leg. In his report, Lister declares modestly: "The remarkable retardation of suppuration, and the immediate conversion of the compound fracture into a simple fracture … were most encouraging facts."

It gets even more encouraging as he goes on to perform surgery on patients in strict aseptic conditions, and not one of them dies. After nine months of experiments, he publishes his promising data in the Lancet: "Papers on a New Method of Treating Compound Fracture, Abscess, etc., With Observations on the Condition of Suppuration." He visits conferences and symposia all over Europe, stating proudly that none of his patients so far have died from sepsis, wound infection or hospital gangrene.



ON A

NEW METHOD OF TREATING COMPOUND FRACTURE, ABSCESS, ETC.

WITH OBSERVATIONS ON THE CONDITIONS OF SUPPURATION.

By JOSEPH LISTER, Esq., F.R.S.,

PROFESSOR OF SURGERY IN THE UNIVERSITY OF GLASGOW.

PART I.—(*Continued.*)

ON COMPOUND FRACTURE.

Case 5.—Charles F——, a fine, intelligent boy, seven years of age, was knocked down at eight P.M. on June 23rd, 1866, by an omnibus crowded with passengers inside and out, and one if not both wheels passed over his right leg, breaking both the bones and inflicting a frightfully extensive wound. The person who brought him to the infirmary said that he had lost a great deal of blood, and the presence of a compress in the ham, placed there by the medical man who saw him at the time of the accident, corroborated this statement. When I saw the child, after an unavoidable delay of three hours, he was greatly prostrated by shock as well as hæmorrhage, so much so that amputation appeared likely to afford but a slender chance of life, although the state of the injured parts seemed at first sight to admit of no alternative. The tibia, which was broken about its middle, lay exposed in a wound occupying almost the entire length and breadth of the inner aspect of the leg, reaching from the inner condyle of the femur to within an inch and a quarter of the tip of the internal malleolus; the skin having been stripped back so as to lay bare the gastrocnemius as well as the bone. The large flap of integument was perforated about two inches from its edge opposite to the seat of fracture, and there was also an opening in the skin on the outer side of the leg, implying that the violence had acted with full effect upon the whole thickness of the limb. Yet the bone was not comminuted, and the muscles, though evidently severely contused, were not much lacerated, while the anterior tibial artery was felt beating in the foot; and, hopeless as would have been the idea of trying to save the limb by

Figure 2: Lancet paper.

Criticism

Despite these remarkable results, most surgeons deem Lister's antiseptic approach a lot of nonsense and moreover, overly complicated. Washing your hands with water and soap is one thing. But drenching your surgical drapes and instruments in phenol? And wearing togs reeking of the same dreadful substance on top of their clothes? Where to put their suture threads, if no longer behind their buttonhole? The biggest criticism however is saved for Lister's phenol nebulizer, which vaporizes a weft of phenol over the wound during the operation. Not unjustly, they wonder whether these vapors are not detrimental to their own airways. Lister's most rabid opponent is James Simpson, the inventor of anesthesia with chlorophorm. Not bothered by any knowledge of Lister's work, he disclaims this whole micro-organism theory as a load of bollocks and

manages to publish his hot-tempered snide remarks in the Lancet. With a demonic orgy of words, he destroys Lister's antiseptic doctrine. But Lister does not let this slander bother him and steadily continues to publish his results in the Lancet. In the meantime, he has found out that pure phenol is too powerful, and that dilutions up to 1:40 have a similar germicide effect. In his nebulizer, which is soon referred to as "the donkey engine", he even manages to work with dilutions up to 1:100.

Sheep gut

Despite these practices of hand hygiene, drenched surgical drapes and germicide nebulizers, wounds continue to suppurate. Lister does not throw in the towel and applies one of his aphorisms: "Success depends upon attention to detail". The detail he decides to put his attention to, is suture threads. Instead of the commonly used silver threads, he introduces suturing with catgut. This thread, made out of sheep guts, is not his own invention. It has been known since Galenus, and not just in medical circles. Violin and lute makers also make use of it. Lister picks up Galenus' old thread but treats it first by prolonged "carbolization". As an experiment, he sutures a deep neck wound in a calf and has the animal slaughtered one month later. To his surprise, there is not a trace of pus on the suture, nor is there any trace left of the catgut!

Back in Edinburgh

In 1870, two renowned Scottish surgeons pass away; the choleric James Simpson dies of a heart attack and James Syme dies of stroke. After the funeral of his father-in-law, Joseph Lister takes over the chair of Clinical Surgery of the University of Edinburgh. He starts applying rigorously what he learned in Glasgow, despite fierce resistance from doctors and the surgery staff. It doesn't help that he keeps coming up with new ideas, such as the rubber drain of Chassaignac. Lister is fascinated with it and immediately applies it to the first abscess that comes his way. It is not just any abscess; it is located in her Majesty Queen Victoria's armpit. With his antiseptic methods, he treats the abscess so meticulously that he earns himself a place on the shortlist of candidates for the title "Sir". But after her recovery, Queen Victoria charges him with an impossible task. A bill to forbid vivisection on animals has long been prepared and awaits approval in the Royal Commission. The Queen asks Lister, of all people, to write an essay against useless experiments on animals; even though Lister himself sees frog legs less as a culinary delicacy than as useful substrates for experiments. He politely tries to explain that animal experiments are indispensable for progress in medicine and that its prohibition may lead to unnecessary human deaths. The Queen is not impressed with his arguments and cuts him from her shortlist for a couple of years.

Citizen of the world

In 1876, Lister discovers America and America discovers him. As a direct consequence of this mutual acquaintance, Charles Goodyear starts manufacturing not only rubber car tires but also rubber gloves around the year 1890. The first surgeon to try these on, is William Halsted of the Johns Hopkins Institute, during a breast amputation that will come to carry his name. Back in Edinburgh, Lister has now reached the respectable age of 50 years and has accomplished just about anything a professor in Surgery can imagine to have accomplished. He is the most famous surgeon of his time, close friend of Pasteur and other scientific celebrities. He leads an operating theater with the lowest mortality rate in the world and in every one of his lectures, students fill the halls to the brim. One of those students is the Brussels-born Gustaaf Borgignon. In the year 1877, Gustaaf Borgignon plays an important role in the diffusion of Lister's doctrines, even if this role has now been largely forgotten. Lister never compiled all of his knowledge on the antiseptic methods in a book, even though he published many articles in scientific journals. In 1877, Borgignon brings together all the knowledge about antiseptics in one book, summarizing the basics and applications of Lister's antiseptic theory: "Chirurgie antiseptique et théorie des germes."

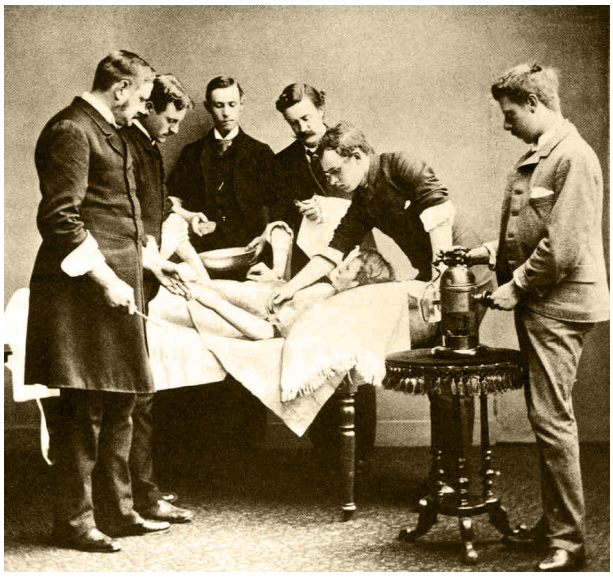


Figure 3: Joseph Lister in the operating theater with students.

London 1877

At the height of his fame, Lister takes a strange decision. He abandons everything he has been building up for years in Edinburgh, and takes off to King's College in London. Nobody understands; his staff nor his students. They even try to convince him to stay with a petition, but Lister is adamant. He is going to London, and he knows why. It's the inner light of the Quakers that has awakened a missionary instinct within him. During his many travels abroad, he has seen that his antiseptic doctrine is practiced now almost everywhere, except for the British capital. The only way to convince the London surgeons of the necessity of antisepsis, is to work with them. Even if it means he will have to start all over again. As expected, a cool welcome awaits him in London. In his inaugural speech, he explains Pasteur's fermentation theory, hoping to persuade the scientists, doctors and students of the importance of sterile surgery. However, disbelief is written all over their faces. The surgeons wonder what these micro-organisms and lactic acid could possibly have to do with surgery? The students, always in for a joke, stamp their feet on the wooden floor and moo as cows every time Lister mentions the term "lactic acid".

The turnaround

The theater staff, too, is initially rather hostile to the new measures. Without raising his voice, but with affable determination, Lister continues to push his antiseptic procedures. He is not very successful until, one day, a man comes in with a fractured knee. Lister does what no surgeon before him would have dared. He opens up the closed fracture, which predisposes it to infection. With his whole arsenal of antiseptic measures, he cuts through the skin, reassembles the shattered pieces of bone and closes the wound. Without the slightest trace of pus, the wound heals perfectly; it becomes the talk of the day in the King's College Hospital. The day after, it even headlines all the newspapers. Soon, some of the surgeons hesitantly begin to visit Lister and ask him to kindly explain again his antiseptic doctrine. A few months later, the mortality rate in King's College Hospital goes down to the level he had brought it in Glasgow and Edinburg. Lister is a happy man; his patients undoubtedly even happier!

Pasteur turns 70

On the 70th birthday of Pasteur, scientists from all over the world come to the Sorbonne to honor the famous French chemist. Of course, Lister is among the 2500 attendees. Over the years, the two scientists have become close friends. Many laudations have been given when Lister takes the floor. He gives an emotional speech, ending with the words: "Truly there does not exist in the wide world an individual to whom medical science owes more than you." Pasteur takes the floor, leaning on chairman Carnot's arm due to his restrained mobility, and expresses his gratitude to everyone who has come such a long way to celebrate his birthday with him. He declares his hope that science and peace may overcome incomprehension and senseless wars. In an emotional moment, he hugs Lister in a cordial embrace. This causes the whole auditorium to stand up and to give both scientists a long, standing ovation. Of all the triumphant moments Lister had experienced in his fruitful life, this was to him surely the most unforgettable.

Sorrow and fame

After Pasteur's celebration, Lister and his wife travel on from Paris to Italy, where they intend to take a well-deserved vacation. In Rappalo, however, Lister's wife catches a cold and unexpectedly dies of pneumonia. After her funeral in London, Lister sinks into a religious melancholy. He will outlive his wife for 19 more years, and is honored during that time by both friend and foe. In 1897, queen Victoria gives her "surgeon-in-ordinary" the title of Baron. It is the first time ever that a physician receives this highest noble title of "Lord". In 1899, the "British Institute of Preventive Medicine" is renamed as the "Lister Institute of Preventive Medicine". When King Edward VII is felled by appendicitis two days before his coronation, Lord Joseph Lister is called upon. And on his 80th birthday, in 1907, a large "Lister conference" is organized in Vienna. Like Pasteur, he is honored extensively for his many contributions to mankind.

Figure 4a & 4b: Listerine: an antiseptic mouthwash.

Posthumous

On the 10th of February, 1912, Joseph Lister passes away at the age of 85 years in his manor in Kent. The funeral takes place in Westminster Abbey. The famous cemetery has a place reserved for such a great man, but Lord Lister had specifically requested to be buried alongside his wife Agnes in the West Hampstead Cemetery.

Buried, but not forgotten. In both London and Glasgow, statues of Lister are erected. On the 100th anniversary of "antiseptic surgery", two stamps are printed in his honor. His name lives on in a number of eponyms too, such as Listeriosis (a disease caused by Listeria monocytogenes), species of orchids (Listera ovata, Listera cordata), a fungus (Listerella) and an antiseptic mouthwash (Listerine®). The latter, a patented brand of mouthwash of uncertain efficacy, Lister would probably not have been very happy about, but all the more with the posthumous laudatio that was written by a Flemish doctor, Hillaire Allaeys, in the monthly magazine "Ons Volk Ontwaakt" (Our People Awaken) of May 1912: "Men like Lister do not die! Without any doubt, his spirit will live on in the thousands and thousands of surgeons worldwide, who will save millions of lives because of his noble and ingenious teachings. Of Lister, we can whole heartedly declare: even in death, he lives on!"

Figure 5: Joseph Lister statue, Portland Place, London, UK.