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The Antiseptic Trio: Pasteur, Lister and Stewart - Their Legacy for Our Times

by

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Abstract

Even with the advances in modern medicine and pharmaceuticals, infectious disease continues to present challenges in this age of HIV/AIDS, public fears of pandemics and resistant strains of microbes. The front line of defence against infectious disease remains rooted in the principles laid down by three pioneers of antiseptics who form a kind of international “antiseptic trio” - Louis Pasteur from France, Joseph Lister from the United Kingdom and John Stewart from Canada. This paper explores the advances made by these men and how their lives intersect.

Many would agree that Louis Pasteur (1822-1895) who was first a chemist, not a physician - laid down the first principles of the struggle against infectious disease. But it was an equally brilliant English surgeon, Joseph Lister (1827-1912), who recognized that Pasteur’s work could save lives lost to even the most minor surgical procedures. Lister, in his search for a solution, examined Pasteur’s findings and deduced that Pasteur was indeed correct; microbes *did* cause disease and death in humans and were transmitted via the air, hands or instruments to wounds and organs by surgery. A Glasgow newspaper report that the sewer workers of the city stifled the stench of the sewers in the summer by using carbolic acid (phenol) led Lister to use dilute carbolic acid to paint wounds and, later, using a machine of his design to “fog” the operating theatre (and everyone in it) with the chemical.

Arriving in Edinburgh from Dalhousie Medical School in 1874 to complete his medical studies, John Stewart, son of an itinerant missionary in Cape Breton, met the then-famous surgeon Lister. Drawn together by their work ethic, religious convictions and intense dedication to the principles of antiseptics, they became the closest of friends until Lister’s death in 1912. When Lister moved to London to take up the “antiseptic cause,” he invited John Stewart to go with him. After two years, Dr. Stewart made the most difficult decision to return to his native Nova Scotia where his father had become quite ill. On his departure, the great surgeon gave Stewart a farewell gift, one of his first “carbolic foggers” which now resides proudly in Dalhousie’s Faculty of Medicine. John Stewart carried the “gospel” of antiseptics to Canada and in 1919 became the Dean of Dalhousie’s Faculty of Medicine.

Introduction

French chemist and microbiologist Louis Pasteur (1822-1895) made many lasting contributions to science, including the founding of stereochemistry, the development of vaccines for anthrax and cholera, and the proof of the germ theory which paved the way

for an understanding of infectious disease and how to prevent its spread. The germ theory states that all putrefying processes (including fermentation and human disease) are caused by invasion of the body by microorganisms. In order to appreciate fully the specific contribution of the germ theory to our understanding of infectious disease, it is important to understand the theories of generation that were being debated in Pasteur's time. Aristotle's view in the Fourth Century BC was that life arises in three ways: by sexual reproduction, asexual reproduction, or spontaneous abiogenesis. Of these, spontaneous abiogenesis was the most controversial, and numerous scientists devised experiments to try to adduce evidence either for or against its existence.

Pasteur's Famous Germ Experiment

It was Pasteur who finally provided compelling evidence that spontaneous abiogenesis does not exist. Here is the problem as he saw it:

I was hoping to make a decisive step by solving, without the least confusion, the celebrated question of spontaneous generation [...] In my opinion, the question was whole and untouched by decisive proofs. What is there in air that provokes organization? Are they germs? Is it a solid? Is it a gas? Is it a fluid? Is it a principle such as ozone? All this was unknown and invited experiment. [...] There was so much obscurity, together with so much passion, on both sides (concerning spontaneous generation) [...] I surmised that the air had to contain the germs that could cause rancidity in the fermentation process and if germs exist in the atmosphere, could they not be arrested on their way?

(Pasteur qtd. After: Vallery-Radot, 1919).

Pasteur's experiment is remarkably simple, but a convincing argument nonetheless against the idea that there are elements in the air capable of spontaneously organizing to create the 'spark of life'. He heated broth in a flask so as to render it sterile. The flask was designed in the shape of a swan neck that communicated with the air, thus permitting the free flow of air in and out. He hypothesized that germs suspended in the air, however, could not enter but would fall on the top of the swan neck, or if they did enter by changes in pressure in the room air, such force would be insufficient to propel them along the tube, and they would get deposited in the swan neck. After a time, Pasteur's broth remained sterile in the swan neck flask, but, remarkably, soon after breaking the swan neck flask to allow direct vertical communication with the air and microorganisms, the broth spoiled. This experiment and others performed in the early 1860s, provided the most compelling evidence at the time that putrefaction was caused by microbes, and that spontaneous generation very likely did not exist.

Lister's Perception of Pasteur's Experiments

Joseph Lister (1827-1912) was born in Essex in 1827 to a family of Quakers. He graduated from medical school in London and became the house surgeon to the famous Dr. James Syme (1799-1870) in Edinburgh. While there, he married Dr. Syme's daughter Agnes, who was a tremendous support to him and his researches. For marrying outside the Quakers, he forfeited membership in the society, and joined the Presbyterian Church, remaining devoutly religious his entire life. In 1860, he became the religious professor of surgery at the University of Glasgow, and during this time he conducted many experiments in granulation, suppuration, and inflammation. John

Stewart called this time Lister's "golden age" as he was making many advances in these fields and also putting the principles of antiseptics into practice for the first time. It was in 1864 that Lister was advised by a colleague in Glasgow to read Pasteur's experiments on putrefaction and the germ theory. He was one of a handful of surgeons at the time who fully understood the implications for his profession of the researches of Pasteur. At this time any wound of the skin as the result of an accident or of an operation performed by the surgeon involved a very "great risk to the patient of serious illnesses called septic diseases, which, indeed, very often proved fatal" (Cheyne, 1925). As Lister saw it, Pasteur had identified the enemy causing the septic diseases that they were after, an enemy that, although not known in any detail, could at least now be targeted in the operating room. Lister himself acknowledges his debt to the great scientist:

But when Pasteur had shown that putrefaction was fermentation caused by the growth of microbes and that these could not arise de novo in the decomposable substance, the problem assumed a more hopeful aspect. If the wound could be treated with some substance which, without doing too serious mischief to the human tissues, would kill the microbes already contained in it and prevent the future access of others in the living state, putrefaction might be prevented, however freely the air with its oxygen might enter.

(Paget, 1914, p. 35).

All lab experiments at this time had used heat and filtration of the air to exclude germs (Cheyne, 1925), so the problem for Lister was to find a new means by which to accomplish this since neither method was suitable for human tissues. Later in the summer of that same fortuitous year of 1864, Lister stumbled on a newspaper article that related the effectiveness of carbolic acid in keeping down the stench in sewers in the town of Carlisle (Cheyne, 1925). Hypothesizing that Carlisle was unwittingly but successfully using an antiseptic in their sewers, he decided to try it as an antiseptic directly on humans undergoing operations. His method was to fog the entire operating room with carbolic acid during the surgical intervention, and to apply it as well to the dressings for the wounds.

Lister's first experiment with carbolic acid was encouraging. He published a paper that describes the treatment of eleven compound fractures. With the use of carbolic acid, only two of these patients developed gangrene, a smaller portion than usual, and they eventually recovered. Germany, being full of many eminent pathologists and physiologists, was one place that took quickly to Listerian methods. In the town of Halle, the surgeon Richard von Volkmann (1830-1889) was operating in an unhealthy hospital in small, overcrowded wards. Nonetheless, he reported remarkable results using Listerian techniques. For example, before using carbolic acid, he reported a surgical mortality of sixty-five percent, and afterward a mortality of only four percent! (Keen, 1915). Equally impressive, the advent of antiseptics allowed surgeons to attempt very bold procedures, and justifiably so, for patients were actually able to survive operations of the head, chest and abdomen, whereas before these areas were too dangerous and had been labeled strictly "*noli me tangere* except in the rare cases when operation was absolutely unavoidable" (Keen, 1915).

Yet despite the impressive results of Lister and his followers, Listerism was not completely accepted in these early years. There are a number of reasons for this. First, the establishment seemed reluctant to accept that "infection in all its various forms was always of bacterial origin, [for it was] a wholly novel and momentous idea" (Keen, 1915).

There seemed to be an element of human pride in this reluctance as many surgeons such as Markoe of New York complained of 'its somewhat arrogant pretension to be the true and only gospel of the surgery of wounds' (Keen, 1915). While in Glasgow and Edinburgh, Lister had a team of young surgeons who were open to his novel ideas and eager to adopt and spread them. In 1877, however, on moving to London to take up the chair of clinical surgery at King's College Hospital, London, Lister was "damned with faint praise" by his elder colleagues and the students who followed them (Keen, 1915). One cannot help but wonder about factors such as pride and the desire for supremacy, and note the irony of a new and successful technique being resisted in London (of all places), which was a centre of research and which ought to have welcomed the new idea. The establishment may have been skeptical for a while even in the face of Lister's great results, but skepticism began to erode upon Robert Koch's (1814-1877) monumental discovery in 1884 that showed that various organisms were capable (when injected into mice and rabbits) of each setting up their own definite diseases, which very closely resembled the different septic diseases which occur in man. This new evidence, which built on Louis Pasteur's (1822-1895) germ theory, made it hard to deny that Lister was fighting the wrong battle.

John Stewart, in the inaugural Listerian oration of 1924, offers some other reasons why it took some time for Listerism to be accepted. He notes that "the average practitioner of the time was not sufficiently educated in the fundamental sciences of chemistry and physiology to appreciate the work of Pasteur and Lister" (Stewart, 1924). Furthermore, there weren't enough statistics gathered early on to overwhelmingly convince the opponents, and "Lister was too busy studying and experimenting to trouble with statistics" (Stewart, 1924). It was actually John Stewart, himself, who was one of the most important figures to help overcome these obstacles.

Dalhousie's John Stewart as Lister's Assistant in Edinburgh

John Stewart (1810-1884) was born in St. George's Channel, Cape Breton in 1848. The son of a Presbyterian clergyman, he began his medical training at Dalhousie and completed his courses in Edinburgh. While there he met Lister and made such an impression on him that he became successively Lister's dresser, clerk, house surgeon and assistant (Gass, 1961). When Lister was elected to the chair of clinical surgery at King's College Hospital in London in 1877, he chose Stewart to be one of four assistants to accompany him. Stewart prospered in London and formed a lasting friendship with his mentor both of them sharing a moral strength that was born of their religious convictions. In addition, he befriended and, with his charisma, won over many of the progressive surgeons of the world who visited Lister's clinic to learn his techniques of antisepsis and who would introduce these techniques in their own countries (Gass, 1961). Despite enjoying great success in London and despite the encouragement of Lister to remain with him, Stewart chose to return to Pictou, Nova Scotia in 1879 to become a general practitioner. For this move, many of even his closest friends criticized him for "burying himself away during these all-important years of surgical renaissance" (Murphy, 1933), but although Stewart chose to return to his people and was not at the epicenter of the surgical revolution during this time, he remained a busy consultant, serving on many medical boards and eventually moving to Halifax to become the Dean of Medicine at Dalhousie.

John Stewart represented [the] new knowledge in Nova Scotia. The doctors of this province, true to the spirit of their art, wanted it for their patients, so, more and more, Stewart was called in consultation throughout the whole province, until in 1894 he moved to Halifax, to practice as a consultant and operating surgeon. His practice became province wide, and his influence on Nova Scotia Medicine ... was profound. That influence spread beyond our provincial borders, for he took an active interest in organized Medicine and served terms as President of the Canadian Medical Association, President of our Provincial Society, and Chairman of the Medical Council of Canada.
(Gass, 1961).

John Stewart was a major figure (along with Lister's other disciples) who spread the new gospel of antiseptics, particularly in Nova Scotia and Canada. It is because of Pasteur, Lister and men like John Stewart who saw the truth of their contributions and worked tirelessly to advocate for them that we can successfully perform sophisticated surgeries. Although the germ theory and antiseptics are so entrenched in our minds, we ought to remember and appreciate the great battle that took place to make it so.

References

1. Blackader AD. *Lister Oration Forward*. Ottawa. Annual Meeting of the Canadian Medical Association, June 18, 1924.
2. Gass CJ. *John Stewart Memorial Lecture*. Tatamagouche, NS, Halifax: Dalhousie Killam Archives, November 8th, 1961.
3. Keen WW. Before and after Lister. *Science* XLI(1067):845-891, 1915.
Lister Joseph. *On the Antiseptic Principle of the Practice of Surgery*, Prometheus Books, Amherst New York, 1996.
4. Murphy GH. *John Stewart Appreciations*. Halifax: Dalhousie Killam Archives, 1933.
5. Paget S. *Pasteur and After Pasteur*, Adam and Charles Black, London, 1914.
6. Stewart J. *Lister Oration*. Ottawa. Annual Meeting of the Canadian Medical Association, June 18, 1924.
7. Vallery-Radot, *Life of Pasteur*, Doubleday, Page and Co., New York, 1919.
8. Watson Cheyne W. *Lister and his Achievement*, Longmans, Green and Co, London, 1925.