Medicine in Stamps

Louis Pasteur (1822–1895): the germ theorist

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"Dans les champs de l'observation, le hasard ne favorise que les espirits préparés"
(Where observation is concerned, chance favours only the prepared mind)

— Louis Pasteur, Inaugural address to Lille Faculty of Science, December 7, 1854.

The origin of disease has always ranked as one of medical history's most tangled and hotly contested topics. Particularly elusive was a cogent explanation for crippling scourges, pestilences and plagues. In the late nineteenth century, a trio of brilliant scientists independently came to the conclusion that microorganisms caused these widespread and dreaded diseases. They were Lister, Koch and Pasteur. Although Louis Pasteur was a French chemist and not a medical doctor, his contributions nonetheless would ultimately save millions of human lives.

FIRST AND FOREMOST A CHEMIST. Born in 1822 to a modest and loving family in Dole, France, Pasteur developed an early talent in pastel chalk portraits and a love of science. He studied chemistry at the prestigious École Normale Supérieure in Paris, and began his early research on crusty residues that formed inside wine barrels. These residues contained tartaric and paratartaric acid, and despite sharing identical chemical structures, one crystal type would rotate polarised light, while another type did not. Pasteur recognised that these chemicals were mirror images of each other, thereby establishing the science of isomers and stereochemistry. In 1854, he was dubbed "the finest chemist in France", and became Professor of Chemistry and Dean of the Faculty of Sciences at the French town of Lille.

FERMENTATION AND THE GERM THEORY. Around this time, beetroot brewers in France complained that certain batches of brew mysteriously turned sour and slimy, while others stayed fresh. They consulted Pasteur the chemist, because they felt that chemical decomposition was to blame. Pasteur visited the breweries and instead studied fresh and spoiled samples under the microscope. Fresh beer contained microscopic round bodies (yeast), whereas spoiled brew had elongated rod-shaped bodies which he named "vibriones". From this observation, Pasteur postulated that fermentation was actively initiated by microbes or "animal infusoria" rather than being a lifeless chemical reaction. Yeast produced the favourable taste of beer and wine by normal fermentation (sugar changed to alcohol) whereas rod-shaped bacteria soured the batch by other metabolic processes.

This fundamental piece of observation and deduction led Pasteur to link fermentation to wound putrefaction. He believed that germs were the cause of suppurating wounds, purulent boils and deadly fevers, a theory at immediate odds with the then popular notion of "spontaneous generation". Pasteur reasoned that microbes, invisible to the naked eye, were transported through air and other contaminated objects, and did not simply arise spontaneously. In a speech before the French Academy of Medicine, he asserted: *"If I had the honour of being a surgeon, not only would I use none but perfectly clean instruments but I would clean my hands with the greatest of care."* He introduced the autoclave, which killed microbes present on surgical gauze and instruments, and this subsequently led British surgeon Joseph Lister to institute sterilisation and aseptic techniques in the operating suites, delivery rooms and wards.

Pasteur's germ or contagion theory also helped to explain the mysterious death of delicate silkworms as they feed on the leaves of mulberry trees before spinning their cocoon of silk. By 1849, pebrine disease (named for the sick worms' black spotted or peppered appearance) was threatening to wipe out Europe's silk industry. Pasteur demonstrated the contagious nature of pebrine disease when healthy worms became ill after they were fed contaminated leaves. Initially criticised by silk merchants who accused the government of choosing a mere chemist instead of a zoologist or silkworm cultivator, Pasteur urged patience, and was eventually able to stop the epidemic by culling out the infected silkworms and mulberry leaves.

PASTEURISATION. One of Pasteur's greatest gifts to mankind is the process that bears his name – pasteurisation. In his small and cluttered laboratory, he had discovered that wine would preserve its taste when gently heated, while microbes present in the wine would be killed. Sealed from the atmosphere, such treated wine would remain as fresh as the day it was made. To showcase his "pasteurisation" process, Pasteur asked for two fresh barrels of wine, heating one and leaving the other at room temperature. Both barrels were then sealed and placed on a sailing ship, not to be opened for some ten months. The fresh taste from the treated barrel contrasted with the sour wine from the untreated barrel, demonstrably proving the efficacy of the process.

Vintners began to heat their wine to 55 degrees centigrade for several minutes to ensure lasting freshness. Pasteurisation saved the French beer and wine industry, and every fresh glass of pasteurised milk that we enjoy today is a tribute to Pasteur's legacy.

VACCINATIONS. Aware of Edward Jenner's vaccine against smallpox a century earlier, Pasteur extended his experiments towards developing a vaccine against anthrax, a serious problem for sheep and cattle farmers. Humans were also contracting anthrax, then known as wool sorter's disease. The German scientist, Robert Koch, had earlier isolated Bacillus anthracis from vitreous humour in 1838, and was successful in growing pure cultures and in re-inoculating animals to produce the disease. Pasteur confirmed these experiments, and established that weakening bacterial cultures with chemicals or exposure to air decreased the agent's virulence. Sheep inoculated with these attenuated cultures developed only a mild illness, and upon recovery, the animals became resistant to anthrax. In a public experiment at Pouilly-le-Fort in 1881, Pasteur showed that 25 vaccinated sheep continued to live and graze undisturbed despite being exposed to a virulent strain of anthrax, whereas unvaccinated sheep perished. Widespread vaccination of sheep and cattle decreased the death rates from 9% to 0.6%, and for this work, France awarded him the Legion of Honor.

Next came rabies. Rabid animals, in the encephalitic phase of disease, would ferociously attack everything in their path, and those bitten would go on to die from the dreaded disease. The only remedy available was cauterisation with a red hot iron, which proved both ineffective and painful. Pasteur suspected that brain tissue harboured the rabies agent, and by drying the tissue for varying lengths of time, he was able to produce attenuated material that protected exposed dogs. On July 6, 1885, a worried mother brought her son, Joseph Meister, to Pasteur's laboratory. While walking home from school, the youngster was brutally attacked by a neighbour's rabid dog. After consulting with medical colleagues, Pasteur administered a series of vaccinations which saved the boy's life. Shortly thereafter, Pasteur was again successful in preventing a second case of rabies in a 14-year-old shepherd who was attacked and bitten by a rabid dog while tending his flock.

OPPOSITION. Like all great scientists, Pasteur faced opposition from influential non-believers. Prominent researchers such as Charlton Bastian refuted his ideas and insisted that putrefaction came from within, not from microorganisms. Felix Pouchet continued to publicise contrary experiments claiming to prove spontaneous generation. In 1860, La Press wrote: *"I am afraid that the experiments you quote, M. Pasteur, will turn against you. The world into which you wish to take us is really too fantastic."* Even Koch disagreed with some of Pasteur's work. Koch, who initiated the research on the anthrax bacillus, questioned the purity and validity of Pasteur's cultures and vaccines, and challenged Pasteur's hypothesis that healthy sheep could be exposed to anthrax by grazing on soil that contained the remains of diseased animals.

A STROKE AT FORTY-SIX. October 19, 1868, was a tragic day for Pasteur. Only 46 years old, he sustained a cerebral haemorrhage that left him with hemiparesis and aphasia. Initially confined to bed for three months, he soon staggered back to his laboratory to continue his work, dragging his left leg behind him. Unfortunately, a relentless series of strokes punctuated the last decades of his life, but he persevered until finally crippled and weakened by angina. By this time, Pasteur was widely acclaimed a genius of science, with recognition coming from his colleague, Sir Joseph Lister, who travelled to France to attend his 70th birthday celebration held at the Sorbonne.

In 1895, at age 73, a final stroke took his life. He was laid to rest in a marble crypt inside a small chapel in the famous Pasteur Institute, forever renowned as *"the chemist, who, though not a physician, illumines medicine and dispels, in the light of his experiments, a darkness which had hitherto remained impenetrable."*

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