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Pasteur, A Chemistry Graduate Who Revoulotionized the Medicine

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Abstract Louis Pasteur, a chemistry graduate and the most illustrious of all investigators although was not even a physician but made many advances in microbiology and introduced the significant "germ theory". He demolished the theory of spontaneous generation, explained the basis for contagion, and introduced rational planning for developing immunity. In 1864, he showed the presence of living cells in fermentation. As a professor at the Sorbonne (1867) his work on tartaric acid led to the discovery of the existence of Crystals in two mirror image form. Pasteur postulated the "germ theory" of disease and showed that the anthrax bacillus could be modified to confer immunity without producing disease. Pasteur used the Latin word "vacca" (meaning cow), first administered the rabies vaccine (1885), for a disease like anthrax, common to animals and human beings. Pasteurization to destroy pathogenic bacteria was introduced by Pasteur. He set up the Pasteur Institute in Paris and served as its first director, and died in 1895.

Keywords Pasteur, Spontaneous generation, The germ theory of disease, Vaccine

The physician and researcher did not know how the body became infected and how diseases spread. The invention of microscope and discovery of one-celled animals invisible to de naked eye called attention to the existence of microscopic organisms. Afterwards, in 1795, Alexander Gordon Realized that Unhygienic midwives carried infection from one childbirth to the next [1]. Pasteur studied specimens of beer fermentation under the microscope and noted that in the healthy fermentation small, round globules were visible, while in the unhealthy specimens long threads appeared. Eventually he concluded that fermentations resulted from the activities of living organisms. When the proper organisms were present (Thread-shaped lactic-acid bacteria in beer), an undesirable fermentation took place [2]. Eventually, he concluded that microorganisms in the air made wine, beer and milk ferment, and showed the presence of living cells in fermentation around 1864. But his findings were opposed by many prominent men who advocated spontaneous generation theory, the old question [3].

Pasteur's discoveries reopened the old controversy of the spontaneous generation of life. Many eminent scientists claimed that they had produced living matter in the form of microscopic organisms. By an ingenious experiment Pasteur demolished this theory. He boiled meat infusions in flasks and observed that putrefaction occurred if the flask was left open, but did not occur if the flask was sealed; the sealed flask remained pure and free of microorganisms. This proved that the organisms which grew in the both were not generated spontaneously, but had been introduced from the air [4]. These experiments were read by Lord Joseph Lister (1827-1912), British surgeon and father of antiseptic surgery. He used carbolic acid and drastically reduced death from post-operative infection [5]. Lister also advocated the use of carbolic acid for the prevention of infection during surgery, and used catgout treated with it to promote ascepsis (1869) [6].

The process of pasteurization or heat treatment of milk, to destroy bacteria had its origin in Pasteur's investigation of the disease which was ruining the wine industry of Jura. He found that certain microorganisms were responsible, but it was impossible to destroy them at high temperatures without spoiling the taste of the wine. Pasteur discovered, however, that he could prevent their growth by heating the wine for a few moments to 50° C. to 60° C. (122° F. to 140° F.) [7]. The method has since been applied to other fields. In all, he developed the method for eliminating microbes from milk-"pasteurization". The heating of milk to a prescribed temperature ensured that milk would cease to be a source of the spread of tuberculosis and typhoid.

1. Germ Theory

The disease that first led to Pasteur's Germ's theory were those of silkworms, and he went on to explore the role of microorganisms in the diseases of cattle, pigs, poultry, and finally, human beings. In 1865 Pasteur undertook an investigation of pebrine, a disease of silkworms that

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threatened the silk industry of France. He identified the cause of the epidemic in the form of round parasites contained in the silkworm eggs and demonstrated that the disease could be eliminated by examining silkworm eggs microscopically, selecting for breeding only parasite-free eggs. Hearing of Robert Koch's experiments with anthrax bacteria, Pasteur wondered if it would be possible to produce an anthrax vaccine as Edward Jenner had done for smallpox. Eventually his research on chicken cholera, swine erysipelas, and anthrax, led to new "vaccine", the term he coined to honour Edward Jenner (1749-1823), British physician who was responsible for the introduction of preventative inoculation for smallpox and was first to describe an anaphylactic reaction to vaccine. Pasteur for showing the worth of his vaccine, on 28 April 1881, he injected 24 sheep with the new vaccine. This was repeated three weeks later. A further forth night later, this group, and a control group of unvaccinated animals were healthy, whereas all the unvaccinated ones were dead or dying. Pasteur's crowning achievement, the rabies vaccine, developed in 1885, was for a disease like anthrax, common to animals and human beings [8]. He began this work in 1880 and after numerous experiments found that weakened preparations of the rabies organism (which could not be seen under the microscope-we now know it to be a virus) could be made from the spinal cords of rabid animals. The first patient was Joseph Meister, a nine–year- old Alsatian boy who had been bitten 14 times by a possibly rabid dog. Pasteur's injection of the weakened virus succeeded in stimulating immunity in the boy before the disease could develop. This achievement brought Pasteur international fame and led to the establishment of the Pasteur Institute in Paris (1888), supported by funds donated from many parts of the world. Pasteur Institutes were founded in other cities in mainland France and in French colonies, principally endowed by private subscriptions.

2. The Highlights

- Pasteur is regarded the father of bacteriology and pasteurization.
- He showed the presence of living cells in fermentation in 1864, at a time when his finding were opposed by many prominent men.
- Pasteur was appointed professor of chemistry at the Sorbonne in 1867 where his work on tartaric acid led to the discovery of the existence of crystals in two mirror image forms.
- He postulated the "germ theory" of disease.
- Pasteur showed that the anthrax bacillus could be modified to confer immunity without producing disease.
- He used the Latin word "vacca", meaning cow, and administrated the first rabies vaccine in 1885.
- He served as the first director of Pasteur Institute in Paris, which was founded in 1888 with a public donation of 2.5 million francs.
- Pasteurization or (heat treatment of milk to destroy bacteria) invented by Louis Pasteur.
- Pasteur Institute in Paris, attempted to produce the therapeutic serum of French bacteriologist Emile Roux, on a large scale.
- Antisepsis finally introduced into obstetrics because of the work of Louis Pasteur and Joseph Lister.
- By 1880, Pasteur and a number of others had identified the organism which was later named "Streptococcus pyogenes" as the cause of the large majority of fatal cases of puerperal fever [9].
- In 1865 (the year of Semmelweis's death), Joseph Lister who was profoundly influenced by Pasteur but totally unaware of Semmelweis's work, developed the principles and practice of antiseptic surgery.
- Before the discovery of microbial pathogens late in the 19th century the prime sources of disease was believed to be "miasma"-poisonous gases given off by unhealthy environments. These included stagnant waters as well as overcrowded slums and rotting animal and vegetable materials [10].
- Pasteur set up the Pasteur Institute in Paris, a research center for the study of contagious diseases.
- Although Pasteurization put the French wine industry on a firm foundation, it has proved even more important in the prevention of milk borne disease.
- He developed a method of vaccination based upon weakening (attenuating) the disease-producing microorganisms. Pasteur inoculated chicken with chicken cholera bacteria that had been weakened by cultivation in the laboratory and showed that animals were immune to further infection. Later he applied a similar technique to develop a vaccine to protect cattle, sheep, horses, and other animals against anthrax [11].
- Spontaneous generation, was a long-discredited notion that certain living organisms arose from nonliving matter. This belief was prevalent until mid-17th century: Francesco Redi (1626-1698), Italian physician and naturalist from Arezzo who is regarded as the father of parasitology disproved the theory of spontaneous generation of maggots, in 1668 [12]. He demonstrated that maggots appear on decaying meat only after flies have laid eggs there. Later, during the mid-19th century, Pasteur proved that bacteria did not develop spontaneously. He killed the organisms by heating bacterial cultures within and prevented further development.
- In fermentation sugar is converted into alcohol through the process of fermentation; and the fermentation of milk causes it to curdle. Its true purpose and nature was grasped by Pasteur who stated that "fermentation is the consequence of life without air [13]." While air-breathing organisms depend upon respiration for their energy, other organisms survive without air by using fermentation [14]. Fermentology, the study of organisms and the process which produces fermentation started with the invention of microscope, and the first description with drawings of

yeast cells was submitted to the Royal Society in London (1680), by a Dutch microscopist Antoni van Leeuwenhoek (1632-1723).

- "Germ theory", the theory that certain disease are caused by specific microbes was suggested long before the discovery of bacteria, but did not receive general acceptance until two centuries after the discovery of this microorganisms. Pasteur, in 1864, demonstrated that microorganisms arise from living "germs" rather than from nonliving matter. From his studies, he concluded that there exists a great variety of microorganisms, each capable of reproducing its own kind. According to this theory, the different fermentations and diseases are caused by different type of microorganisms.

In the early part of the 19th century convincing evidence was offered that certain plant diseases, such as the potato blight were caused by fungi. The German pioneer bacteriologist Robert Koch (1843-1910), who studied the anthrax bacillus and showed it to be the sole cause of disease conclusively demonstrated that anthrax, a disease of animals and man, was caused by the Bacillus anthracis [15].

In establishing the relation between an organism and a disease, Robert Koch applied a series of critical conditions that have become known as "Koch's postulates." Koch's conditions may be summarized as follows; (1) wherever the disease is found, the germ must be found; (2) the germ must be grown in isolation from all other germs; (3) when the germ is introduced into a healthy, susceptible animal, it must produce the disease; and (4) it must be possible to grow the germ from the disease tissues of this animal [16].

Figure 1. Louis Pasteur, the father of microbiology. Pasteur among the children who were saved from rabies

3. Life

Louis Pasteur (1822-1895), the most illustrious of all investigators, was not even a physician, but a chemistry graduate of the École Normale supérieur, the leading science school in Paris. Born a tanner's son from the Jura mountains near the Swiss border, Pasteur trained as a chemist, becoming a professor in Strasburg, river port of eastern France on the Ill River, and Lille, regional capital of northern France, and then Paris. His interest in microorganisms was triggered by analysing the activity of certain chemicals, especially the tartrates, and this led to a growing fascination with fermentation. Puzzles regarding wine-and beer-making drew him to microorganisms such as yeast [17].

Pasteur undertook an investigation of pebrine, a disease of silkworms and identified the cause of the epidemic in 1865. Shortly after completing this work, Pasteur suffered a stroke, which paralysed his entire left side. He returned to work three month later, and although some effects of the stroke remained, he accomplished some of his finest work in the remaining years of his life [18].

He devised experiments to disprove the old notion of spontaneous generation, started his study on fermentation in 1857, and demonstrated the presence of living cells in fermentation around 1864, at a time that his findings were opposed by several prominent men who advocated the spontaneous generation theory [19].

He developed a method for eliminating microbes from milk "the now familiar" pasteurization [20]. Pasteur postulated the "germ theory" of disease. His crowning achievement, the rabies vaccine, developed in 1885, was for a disease, like anthrax, common to animals and human beings. This vaccine, the greatest achievement of Pasteur brought him international fame and led to the establishment of the Pasteur Institute, in Paris, supported by 2.5 million francs donated from many parts of the world. Pasteur died in 1895 holding in one hand the hand of his wife and in the other a crucifix, a mark of Pasteur's devout religious faith, to which he had been loyal all his life [21].

4. Conclusions and Impact

Louis Pasteur simultaneously demolished the theory of spontaneous generation by his monumental experiments. He firmly established the "germ theory" of disease, explained the effectiveness of the asepsis and antisepsis of Ignaz Philipp Semmelweis (1818-1866), Hungarian obstetrician who studied puerperal fever, its causes and spread and introduced strict hygienic measures to reduce mortality rate, and Joseph Lister (1827-1912), British surgeon and father of antiseptic surgery who used carbolic acid and drastically reduced death rate from post-operative infection. The impact of the germ theory was especially profound in the practice of surgery. Lister developed an arry of antiseptic techniques, constructing phenol spray to cover the wound and surrounding areas during operations and using dressing soaked in phenol to diminish post-operative infection. Later still, the surgical instruments, which both Pasteur and Robert Koch (1843-1910), German pioneer bacteriologist had recommended boiling, and the hands and clothes of surgeons became incorporated into aseptic regimes, as did the use of protective gowns, masks, and gloves [22].

His rabies vaccine, made using the spinal cords of rabbits gained him wide spread public and world acclaim, for it represented the first time that Pasteur's method had been applied directly to human being. In the UK, a public collection in acknowledgment of Pasteur's rabies work raised over 2000 pounds, which led to the establishment in 1891 of

the British Institute for Preventive Medicine (later called the Jenner, and later still the Lister, Institute). With an endowment of 250000 pounds from Lord Iveagh, a member of the Guinness brewing family, it acquired a purpose-built site on the Chelsea Endowment in London [23].

From then on, bacteriology and immunology followed an ever-widening course. Émile Roux (1853-1933), French bacteriologist and Pasteur's pupil who worked on rabies and anthrax vaccine, developed treatment with antitoxin of diphtheria bacillus and immunization with the toxin. Together with Alexander Émile John Yersin (1863-1943), Swiss-born French microbiologist, Roux isolated the diphtheria bacillus and developed an antitoxin. Gradually more and more bacteria were discovered, numbers of vaccines and antisera were produced, and the mechanisms of prevention became increasingly clarified [24].

Trained as a chemist, Pasteur laid the basis to the biological preventive measures for future.

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