

## THE BICENTENARY OF THE GREAT SCIENTIST - LOUIS PASTEUR

### BICENTENARUL MARELUI SAVANT - LOUIS PASTEUR

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**Abstract.** Moving to the East of France, Jura-land, the Pasteurian land, allowed us to get to know up close a hilly area on the border with Switzerland which is very favourable for grapes. The viticulture sector, being developed in Bourgogne since ancient times, has attracted the attention of many scholars and artists. One of them was the great Pasteur, whose Museum-House is located in the small town of Arbois, a large wine-growing center. Throughout the summer and autumn of 2022, under the auspices of the Academy of Sciences and the "Terre de Louis Pasteur" cultural team, events, symposia, festivals, and meetings with scientists are organized to commemorate the bicentennial jubilee. Admirable are the places where the future scientist lived, the local church, the house where he went to school and the laboratory of the great French microbiologist Louis Pasteur (27.12.1822–28.09.1895). Born near Dole (70 km North), his parents bought (in 1830) a four-level house right on the banks of the Cuisance river, where on the 1<sup>st</sup> and 2<sup>nd</sup> floors were his residence, the upper 3<sup>rd</sup> and 4<sup>th</sup> floors were intended for science. The article reveals the concerns of the scientist in whose laboratories they studied: microbiology, vaccines, hygiene, sanitation, immunity, the process of acquiring table salt from underground water, the biochemistry of fermentation and pasteurization.

**Key words:** scientist, studies, microflora, grapes, wine, Jura terroir, wine diseases.

**Rezumat.** Deplasarea în Estul Franței, Jura-land, plaiul pasteurian a permis cunoașterea îndeeaproape a unei zone colinare la hotarul cu Elveția foarte favorabilă pentru struguri. Filiera vitivinicolă fiind dezvoltată în Bourgogne încă din evul mediu, a atras atenția multor savanți și oameni de artă. Unul din ei a fost marele Pasteur, Casa-muzeu este situată în orașelul Arbois, mare centru vitivinicol. Toată vara și toamna anului 2022, sub egida Academiei de Științe și echipei culturale „Terre de Louis Pasteur”, sunt organizate manifestări, simpozioane, festivaluri, întâlniri cu savanți pentru comemorarea jubileului bicentenar. De admirat locurile pe unde a pășit viitorul om de știință, biserica locală, casa de unde a plecat la școală și laboratorul marelui microbiolog francez Louis Pasteur (27.12.1822–28.09.1895). Născut în preajmă, în orașelul Dole (70 km Nord), părinții au procurat (în 1830) o casă cu patru nivele chiar pe malul râului Cuisance, la nivelul 1 și 2 era domiciliu, etajele de sus 3 și 4 au fost destinate științei. Articolul dezvăluie preocupările savantului în laboratoarele căruia s-au studiat: microbiologia, vaccinarea, igiena, sanitară, imunitatea, procesul dobândirii din apa subterană a sării de masă, biochimia fermentației, pasteurizarea.

**Cuvinte cheie:** savant, studii, microflora, struguri, vin, terroir Jura, bolile vinului.

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### **1. Franche-Comté de Bourgogne – home of great personalities**

At the beginning of the 19<sup>th</sup> century, the role of science is increasingly felt, the transition from manufacturing to the productive industrial form, an ascent against the backdrop of a divided society, revolutions and social dramas. Science becomes an integral part of the ensemble of social phenomena, related to knowledge of objective nature. France occupies a leading place, famous chemists and physicists carried out their activities here. The list of aboriginal personalities of the Franche-Comté region includes: the chemist-microbiologist Louis Pasteur, the glaciologist Claude Lorius, the physicist Jean Claude Eugène Péclet, the writer Victor Hugo, the cinematographer Auguste Lumière and the utopian thinker Charles Fourier.

In the biography of the great scientist Louis Pasteur, whose bicentenary we celebrate this year (27.12.1822), we highlight the qualities taken from the nature and tradition of the Franche-Comté region, the Jura department (TopoGuides, Sentiers des patrimoines, 2012), creative inspiration and diligence, often sung and painted in regional art. The old Celtic region, the Sequania with its extensive forests and fertile land, Franche-Comté eventually becomes a free county, the cradle of a population that never surrendered to foreigners, because it has brave men, famous in the Crusades.

With feelings from the visit to the Arbois House-Museum, we raise the bibliographic sources (Roux, 1896; Nicolle, 1953) to encompass the greatness of the “Pasteurian mountain”, which helped us to come up with this jubilee memoir. The region has a tradition of preserving historical relics: old buildings, churches, the cathedral, the house-museum dating back to the XIX century. Over time, the House where the master lived was donated by the great scientist’s descendants (in 1935) - to the Society of Friends of Pasteur, and then (in 1992) - ceded to the French Academy of Sciences (Académie des Sciences), which classified it as a protected historical monument, named in 2011 “House of the Illustrious”, now support and by the Foundation Heritage from Bourgogne.

This year the Jura department supports multiple festivities, issued a jubilee stamp, and announced the timetable for the open doors at the museums in Dole and Arbois, the night of museums “*Pasteur – inspire*”, the digital exhibition “*Pasteur Space*” (Prospectus: Journée Hommage à Pasteur, 2022; [www.terredelouispasteur.fr](http://www.terredelouispasteur.fr)). This August, here at the House - museum they were many visitors, I went through rooms with furniture and inventory of two centuries, laboratories, and a rich intact library. In city center of Arbois it is raised a beautiful monument of Louis Pasteur with bas-reliefs of the parents and other episodes from life his effervescent.

### **2. Studies, passions and romance**

The Master passes his adolescence on revolutionary wave, in a period of turmoil social, in 1848 sweeps away the feudal order after the difficult years of Napoleon’s wars. A native of the Franche-Comté region in the East of France, even if the city of Dole was the place of his birth, from the age of three he moved

permanently with his family to the commune of Arbois. He visited the city of Dole precisely in 1883, as an invited scholar on the occasion of the unveiling of the memorial plaque where he was born.

The favourite place for the family becomes Arbois in the Jura mountains (TopoGuides, Sentiers des patrimoines, 2012; [www.terredelouispasteur.fr](http://www.terredelouispasteur.fr)), where they admired nature, participated in shepherding and viticulture, you could make observations related to chemistry: skin tanning, winemaking, cheese production, cloth dyeing, bread baking, beer making and the acquisition of kitchen salt. Redeemed from serfdom, the great-grandfather becomes a tanner in Salins, a small town that owes its name to salt exploitation since the XIII century. The great-grandfather of the scientist still owned pelts processing units, an occupation also passed on to his son Jan-Josef Pasteur, a former officer in the Napoleonic army. The ex-soldier is looking for a more suitable place for entrepreneurship, a big city – Dole, where Louis is born (in 1822). The scientist's mother, Jeanne-Etiennette Roqui, cultivated kindness, perseverance and responsibility, special qualities in the future scientist. The Pasteur family is in search, they settle in Arbois, the slum of Courcelles, they buy the house on the banks of the Cuisance river with its bubbling rocks and waterfalls.

In the inherited paternal House, you had a place to receive guests-colleagues, you could play a game of billiards, make experiences, always returning in the summer from other cities, where he had gone to study. It is the second city that shaped him as a personality, during his primary school and college years he was active multilaterally, chemistry attracted him and he set up his laboratory on the upper floors. An ordinary child, more withdrawn than others, without resounding successes, but contented, with good drawing skills, he is guided by the pedagogue Romanet, director of the Arbois college, who saw the moral qualities and intellectual possibilities of young Louis (Tăutu, 1959).

The third city - Besançon is the capital of French-Comté, where the teenager continues his studies at college (until 1838), lives alongside Hugo's romantic drama and Fourier's dreams, begins tutoring in physics, takes care of painting (portraitist). The portraits of the parents painted in pastels when Louis was 15 were kept in the museum. At the same time, he takes the baccalaureate exams in literature and mathematics (in 1840).

The talented teenager, who went to Paris at the age of 18 in search of his destiny, dreamed of entering two higher schools – a pedagogic school and a polytechnic, is preparing for admission and supports himself as a tutor in the Latin quarter. He voluntarily attended the lessons of the famous organic chemist Jean-Baptiste Dumas, where he understood that he would become a chemist. In 1843, at the age of 21, he became a student at the Superior Normal School, he also worked in the Sorbonne laboratories, alongside the great chemists: Auguste Laurent, Pierre Eugène Marcellin Berthelot, Claude Bernard, widely practicing experiments related to nature and practical needs, takes the first steps towards research, studies the fundamental disciplines.

In the first works of optical research with molecular asymmetry he studied the structure of tartaric acid crystals and the connection with their optical activity. Pasteur learns from the paper about the optically inactive phenomenon of mesotartaric acid, similar in structure to tartaric acid but with different properties. The young scientist's first papers, bachelor's thesis and publications were on crystallography (optical physics): *I am led to believe that life depends on the dissymmetry of the Universe - penicillium uses the left albumin in solution and ignores the right one.*

The romantic vision leaves traces in the entire work, because the classical scholar demands the concrete, the romantic scholar - the abstract, only their integration leads to the result. In the biographical speeches, his regrets regarding the abandonment of crystallographic studies are emphasized (Имшенецкий, 1961; Шевелев and Николаева, 1988). In fact, the destruction in the human body of one of two asymmetric substances (penicillin) made the scientist move his research into the world of physiology and medicine. The optically active phenomenon of tartaric acid and inactive race mate led to the hypothesis of the existence of atoms, which 20 years later, the Dutchman Van't Hoff created the science of stereochemistry.

The young teacher shows social activity, has meetings, is actively trained in the daily life of the Jura region (gives consultations at Salins-les-Bains), where the salt used widely for food preservation was acquired. After graduating from the normal school, he begins his professional activity, teaches courses as a professor at the University of Strasbourg (in 1849), here he marries the Rector's daughter, studies the artificial regulation of human immunity which led to the foundation of immunology. From 1854 he was appointed dean and professor of chemistry at the university of Lille, the center of the sugar industry and fermentation branches, he studied the mechanism of alcoholic fermentation.

### 3. The fall of mythology and vitalism theory

Experiments with fermentation begin in Flanders, continue in Paris (in 1867), plead for combining with practice, motivating the students: *whoever has a potato can get sugar, acid, alcohol, ester or vinegar from it.* Pasteur cultivates the desire for progress in his collaborators, who are constantly encouraged - they participate in the overthrow of the so-called "*vitalism theory*". The mythology of fermentation dominated until the discovery of the microscope, Antonie van Leeuwenhoek, in 1673, falls. Further, the vitalism spirit denied research, and fermentation - related only to microbes, a consideration condemned by Claude Bernard. Along with Pasteur, a number of scientists contributed to this: the experimental obtaining of oxalic acid (Wohler, 1824), the synthesis of fats (Berthelot, 1854), of sugar (Butlerov, 1861) lead to the fall of vitalism, opening perspectives towards organic syntheses.

Knowing the chemical origin of fermentation, in which sugar is split into ethanol and carbon dioxide, makes Pasteur emotionally return to Lavoisier's work. The experiences in his laboratory regarding the biochemical process of

fermentation from the activity of microorganisms differentiated alcoholic, lactic, propionic, oleic, acetobacterial fermentation and others, the result being remarkable.

The idea of separating pure cultures is advanced, from them some that develop in the absence of oxygen have been selected, thus creating a biological chapter called - anaerobic. It is that microflora that for millennia benefit mankind in the preparation of bread, beer, wine or dairy products, they all have branchial biological activity, in fact the integration of chemistry with biology, oenology, etc. has been seen. As for the wine industry, the dream of the great scientist to have the wine industry developed has come true: today he discovered the chateau and Jura terroir wines (Tăutu, 1959).

He later evaluated the biochemical theory of fermentation, based on the action of low-energy enzymes. The "*Pasteur effect*" arose due to the observation of the predominance of glycolysis in fermentation over oxidation processes. Due to the reversible activity between adenosine di-triphosphate (ADP=ATP), found in most plants, microorganisms and animals as a biochemical process, a process accessed with approximately 20 times less energy, compared to OR processes. Knowing the threshold of reduced sugar concentration and oxygen dosing in the first phase has now found wide use in the cultivation of yeast biomass in winemaking. At the same time, the scientist's team discovered the anaerobic process in some microorganisms, laid the foundations of modern winemaking through the book "*Recherche du vin*" (in 1866).

As a result of thorough studies of wine diseases, Pasteur proposes an effective method of combating it - pasteurization, considered as classical stabilization in bottles: 10-20 min at a temperature of 55-75°C. Thanks to the sterilization of food products, today it is widely used in juices, dairy in bottles or made today in continuous machines (Балануца and Вакарчук, 1986). Pasteurization is applied for many purposes: biological, physical-chemical stabilization, reaching maturity, improving the quality of red or semi-sweet wines. Today we have perfect devices - with configured plates that ensure the turbulent regime in the flow, in hermetic conditions (without oxygen). The complex is ensured: the inactivation of the microflora, the degradation of some enzymes, the coagulation of thermolabile colloids, and depending on the physical-chemical factors, the pasteurizing unit (UP) is proposed: heating the product to 60°C for 1 minute.

#### 4. Pasteur and medicine

In tangent with the diseases were the subsequent researches, recommended by the Academy of Sciences regarding the problem of mass brushing of silkworms. The application of traditional treatments gave poor results. Pasteur and his wife for 5 years study the aetiology, microflora, factors and changes in 2 stages: internal and external - of change. The scientist's recommendation was simple, the application of sanitary and hygienic conditions.

Starting from the 1870's (19<sup>th</sup> century), Pasteur deals with infectious diseases in animals and humans, from which the new science - microbiology - will emerge. At that time, many advocated against the hypothesis that infections have an external origin, it took hundreds of sanitary experiences in hospitals to reduce obstetric sepsis. Pasteur's research had a wide echo in the world, it is enough to mention the works of the well-known English surgeon Joseph Lister (in 1867), from the ideas of the Frenchman he draws conclusions that the infections of the operated wounds are still microbial, thus the practice of aseptic is born.

After 1877, medical research intensified, they began to select specific microbes for each disease such as: cholera, anthrax, smallpox. They took from the Chinese tradition to sprinkle the wounds with the dust of the dry skin of the sick person, another kind, also used by the English doctor Edward Jenner. After a lot of time and trials, the laboratory establishes the legitimacy of these actions - its universality, calling it a vaccine, an innovative new direction of preventing infectious diseases through artificial immunity.

Coming with a communication to the French Academy, Pasteur declared openness to the total fight against anthrax with the help of the vaccine, which was regarded at that time as something fantastic. Veterinarians saw this as replacing clinical medicine with an embryonic theory. Dozens of field experiments with infected cattle were used, all of the vaccinated ones remaining alive. Pasteur's theory was coming to life.

In 1882 Pasteur is elected a member of the French Academy, he delivers an emotional speech full of devotion to science. Invited to Scotland for the tercentennial ceremony of the University of Edinburgh, the master salutes France, again urging young people to embrace science with obvious enthusiasm on the path of progress. Along with the personalities in law and theology, the Doctor of Law Diploma was handed to Pasteur, comically announcing: *In matters of laws – he only recognizes physical-chemical laws!* The chaos of the cholera epidemic in Egypt follows (1883), the English authorities oppose the quarantine, the natives run away from the hospitals, the epidemic kills hundreds of people a day. In the master's laboratory, the team of volunteers for the medical mission is formed, which, in collaboration with Robert Koch, discovers the vibrio in the intestine, the dramatic situation ends.

In the case of swine fever infection, it was more difficult, when it was established that you cannot grow it in test tubes, but in living organ - in rabbits, as a result, thousands of pigs were practically saved in epizootic districts. At the time when Pasteur was thinking about the prospect of applying the vaccine against epidemics and to humans, most of the opponents were against it, the author was called "*the alchemist, the microbe fanatic*", especially by the doctors of the vase (in 1883). The scientist believed that the changes in the body are caused by the external agent, the negative changes occur when exogenous micro-organisms find themselves in a foreign environment and cause changes (the existence of viruses was assumed).

Together with Ilia Ilici Mecnikov, he discusses the action of some microbes, phenomenon - microbial antagonism, which leads to the invention of antibiotics. Not being a doctor by profession, Pasteur sought support for the concept of vaccination among leading doctors, many of whom were against it. Precious time was being lost in polemics, there was a gap between bio-natural sciences and medicine, experiment and theoretical science, and Pasteur's role was to lay the foundation of immunology, so the future belongs to preventive medicine.

The thirst to explore the unknown is natural to him, he did not contain it neither when he was preoccupied with the peripneumonia of cattle, nor when he was studying the bellowing of pigs or the danger of rabies. Witness in the research, Roux writes: *“the master shared the horror of rabies since childhood, those bitten by dogs had a tragic end, and the healing of wounds in the forge left unforgettable suffering”*. Pasteur accepts the fight against infection with thought - as a benefit to mankind, but also as a triumph of his doctrine.

The team fights for four years, initially having the remedy invisible under the microscope, that substrate that passes through the filter, later called the virus. Based on the experiences of Pierre-Victor Galtier (in 1879), as the disease does not spread spontaneously and attacks the nervous system, the study begins by looking for the material and the safe dose of vaccine inoculation. Subcutaneous inoculations withhold treatment, while in rabbits it had a rapid incubation of 6 days. The modified preparation of the vaccine outside the body is proposed: fragment from the marrow of the rabid rabbit: dry sterile, in the dark, at 20°C, it gives results, rabies is (in 1884) faced. The ingenuity of the sick - paralyzed master, to dose a special vaccine that overcomes the action of the poison from the man bitten by the dog, whence - the question: without Pasteur would the way to treat rabies have been discovered?

Pasteur distinguished himself in many fields, but the practical significance undoubtedly belongs to medicine. Scholars of international stature, invited on the occasion of the 70<sup>th</sup> anniversary of his birth (in 1892), had laudatory speeches to the scholar, after which his son read the response message, the organizer announced - the Academy decorated him with the large gold medal engraved: *“Louis Pasteur on the occasion of 70 years - gratitude from science and humanity!”*. The scientist's health gradually declined and in 1895 he died, and the remaining work is immortalized by the Pasteur Institute, where there is also a funerary plaque on the ark at the entrance written: *“Ici repose Pasteur”*.

## CONCLUSIONS

1. Pasteur's brilliant ideas are current after more than a century, the methodology of experiments, the rotation of microorganisms in nature, to which both the disintegration and accumulation of substances on the globe belong.

2. The role of the scientist is to study the optical activity and asymmetry of the chemical substances from which stereochemistry originated, successfully solving some chemical, technical, biological and physiological problems.

3. From the Pasteurian scientific view comes the perspective of immunizing the population by vaccination against dozens of infectious diseases.

4. Discovering the anaerobiosis of bacteria, Pasteur paves the way for the theory and practice of the science of microbiology and the wide application of enzymatic biochemical processes in technique and technology.

5. The investigations related to the invisible microbes in rabies and the cultivation of the vaccine on living organisms generated the assumption of the existence of a new matter (viruses), today science - virology, a widely discussed topic (COVID 19).

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