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ILLUSTRATED CATALOGUE

PASTEUR

EXHIBITION

SCIENCE MUSEUM, SOUTH KENSINGTON

9th April–26th May, 1947

Price: One and Sixpence

The PASTEUR EXHIBITION, which was shown last year at the Palais de la Découverte in Paris, was planned as part of U.N.E.S.C.O.'s International Month. It is now on view at the Science Museum, under the patronage of H.E. the French Ambassador, and through the courtesy of the Director, Dr. H. Shaw.

The exhibition has been brought to England with the assistance of the Cultural Relations Department of the French Foreign Office. We are greatly indebted to the Ministry of Works, who have made themselves responsible for the installation. We should also like to express our warm thanks to the staff of the Science Museum for all their assistance.

In addition to the exhibits which were on view at the Palais de la Découverte, a section has been generously loaned by the Wellcome Historical Medical Museum, two models of crystals by Dr. C. A. Beevers, Dewar Crystallography Laboratory, Chemical Department, Edinburgh, and a microscope by Messrs. Whitbread.

A. LÉVEILLÉ
Director
Palais de la Découverte

PASTEUR
AND BRITAIN

In 1941, in the darkest days of the German occupation, all our hopes in France were fixed on Britain, that magnificent nation which, standing alone, had withstood the tremendous shock of the German air armada and, though almost unarmed, had defeated it in the London skies.

I wondered how I could give our British friends a token of my faith and admiration. I could only think of one way, to send to one of the greatest British scientists, my distinguished friend Sir Henry Dale, a souvenir of one of the greatest Frenchmen, Pasteur, who had loved Britain as much as he hated Germany.

I sent Sir Henry Dale a few lines written in Pasteur's own hand in 1856; it was his thanks for the Rumford Medal which he received from the Royal Society for his work on crystallography.

Pasteur was then thirty-four, and it was his first contact with British scientists.

A few days after receiving this medal, in December 1856, Pasteur presented himself as a candidate for the Académie des

Sciences. A fierce contest ensued between him and another scientist, M. Delafosse. Pasteur's scientific titles were questioned, and he appealed for help to the Royal Society. On February 27, 1857, he wrote to one of the Fellows, the mineralogist, Professor Miller:

"In a certain matter now under review, and which will determine my future, my work on crystallography and the value of my research on the possible relations between the physical properties of minerals and their internal molecular constitution, are being contested.

"This incident makes me feel that my work is not appreciated in France as it should be, and so I am addressing myself to you, as one of the scientists of Europe best qualified to give a judgment, to ask you to give me your opinion and to tell me what value you attribute to my work from the point of view stated above."

Nevertheless, Pasteur was defeated.

* * * *

After his discoveries in the field of crystallography which revealed the relationship between the external form of crystals, their chemical composition, and their action on polarised light —work which laid the foundations of a new science, stereochemistry—Pasteur, as a logical consequence of his researches, showed that fermentation is due to living bodies, and explained its mode of action. This work won him the Copley Medal, again awarded to him by the Royal Society.

Thus, at each step in Pasteur's scientific career we see Britain acknowledging, encouraging, and supporting him: first the Rumford Medal, then the Copley Medal, both awarded to him by the great scientists of Britain.

When he had shown that the ''diseases'' of wines could be prevented by heat, Pasteur devoted himself to ''diseases'' of beer; the aim being a stable product.

This research was inspired by our troubles of 1870. He started work immediately after the Franco-Prussian War and carried on ''in the determination to bring it far enough to ensure continued progress for an industry in which Germany was ahead of us''.

Where should he go to learn about methods of brewing if not to England? Pasteur came to London in September 1871, and in the Whitbread breweries made observations which astonished the brewers. He showed them the value of studying yeast under the microscope in order to avoid faulty methods of production.

* * * *

Even before Pasteur started to apply his methods to the study of virulent diseases, the great surgeon, Lister, had perceived the consequences which Pasteur's work could have in surgery: he had in fact founded the antiseptic method.

Here is the letter he wrote to Pasteur:

Edinburgh, February 18, 1874.

I do not know whether you ever see British publications on surgical questions. If you do, you will, from time to time, have read of the antiseptic method which, for the past nine years, I have been attempting to bring to perfection.

Allow me to take this opportunity of sending you my most cordial thanks for having, by your brilliant research, proved the validity of the theory of putrefaction of germs, thus giving me the only principle which could bring the antiseptic method to completion.

If you ever come to Edinburgh it will, I hope, be a true reward for you to see at our hospital how greatly the human race has benefited by your work. Need I add how keen a pleasure it would be for me to show you here what surgery owes to you ?

Please forgive my outspokenness, which is prompted by our mutual love of science. Will you accept my profound respect, and believe me,

Most sincerely yours,

Joseph Lister.

It was only in 1877 that Pasteur began to study virulent diseases with the methods which had led him to discover the agents involved in fermentation.

Until then he had not dared because he was neither a doctor nor a veterinary surgeon. He wanted first to learn about medicine. So he presented himself as a candidate for the Académie de Médecine. He was elected—by a majority of one!

He tried to convince the medical world of the non-spontaneous nature of microscopic organisms. No organism is generated spontaneously, he declared, whether it be in a fermentable medium or in the body.

But spontaneous generation still had its devotees. One of the most ardent was a young British scientist, Dr. Bastian. He attacked Pasteur's work violently while, on the other hand, the great British physicist, Tyndall, upheld it with all the weight of his authority.

Here is the letter that Tyndall wrote to Pasteur:

February 16, 1876.

Dear M. Pasteur,

During the last few years a number of works bearing the titles "Beginnings of Life", "Evolution, or the origin of

Life'', etc., have been published in England by Dr. Bastian, a young physician (medicine). He has also published a considerable number of articles in various magazines and journals. The circumstantial manner in which he has described his experiments and the confident tone with which he has advanced his conclusions have produced a very considerable impression upon both the English and the American public. The point of greatest practical importance, however, is the influence which his writings have exercised upon the medical profession. He has attacked your labours with great vivacity and, although he has produced but little impression upon those who are intimately acquainted with your writings, he has produced a very great and, I would add, a very mischievous impression upon others.

The confusion and the uncertainty had at length become so great that six months ago I thought it would be doing service to science and justice to you to undertake a new investigation of the question.

Following out suggestions that had occurred to me six years before, and the nature of which are indicated in the paper published in the ''British Medical Journal'', which I had recently the pleasure of sending to you, I have gone over a great deal of the ground taken up by Dr. Bastian, and have, I trust, refuted many of the errors by which the public were misled. The change which has occurred in the tone of the medical journals of England is very remarkable, and I am inclined to believe that the public faith generally in Dr. Bastian's accuracy has been considerably shaken.

While pursuing this enquiry, I have had occasion to refresh my memory of your writings, and they have revived within me all the admiration with which I first perused them. It is my

intention to pursue these researches until every doubt regarding the unassailable accuracy of your position has been removed.

For the first time in history we have reason to entertain the sure and certain hope that, as regards epidemic disease, medicine will soon be rescued from empiricism and placed upon real scientific foundations; when that day comes, humanity, in my opinion, will acknowledge that their largest share of gratitude is due to you.

Believe me,

Ever truly yours,

John Tyndall.

I do not think the germs of bacteria come within the range of the microscope.

However, on July 10, 1876, Bastian presented a communication to the Académie des Sciences of Paris. In it he showed that when a specimen of urine is brought to boiling point, under conditions excluding any possibility of contamination by atmospheric organisms, and with the addition of a solution of potassium boiled so as to render it slightly alkaline, if the urine is then subjected to a temperature of 50 degrees centigrade in a hot-air oven, it is found to be swarming with bacteria.

Pasteur, with Chamberland and Joubert, repeated Bastian's experiment—it worked!

Had spontaneous generation of bacteria occurred in the urine? No, he told himself: but where do the bacteria come from? From the solution of potassium? From the urine? From the walls of the receptacle?

Pasteur observed that one has to bring the urine, which is alkaline, to a temperature of 115 degrees centigrade in order to be certain of destroying all the organisms. This work gave us the autoclave and the Pasteur oven.

And so Bastian's opposition had proved useful. This is what happened all through Pasteur's life: opposition always stimulated him to new experiments which brought the technique of pasteurisation to its perfection.

* * * *

1877–1881. These are the grand years. Pasteur, encouraged by his studies on the diseases of silkworms, which had revealed to him the part played by germs in the development of a hereditary and infectious disease, moves on to attack the problem of cow-pox. He proves, with superb logic and unequalled mastery, that the disease is, in fact, due to a micro-organism, and he shows how it can be reproduced with unfailing certainty by the use of a minute portion of a culture of this micro-organism.

He studies the vibrio septique, an anaerobic organism, the cause of the condition which was later to be called gas gangrene. He discovers the organisms of boils, of osteomyelitis, and of puerperal fever. He goes from conquest to conquest, the most renowned being the discovery of vaccination by attenuated organisms.

In July 1881, the British invited Pasteur to take part in an International medical congress in London.

The congress began on August 3. Pasteur presented a communication which has remained famous in the history of science. Here are the opening lines:

"I came to London for two reasons: first, for my own instruction and to profit by your learned discussions; second, to state the significance of the theory of germs in medicine and in surgery to-day. I shall certainly return to Paris well satisfied. In this week I have learnt much. I carry away with me the conviction that the British people is a great people; and where

the influence of the new doctrine is concerned I have been struck, not simply by its progress, but by its triumph. I should be guilty of ingratitude and of false modesty if I mis-prized your sentiments by failing to give to the welcome I have received from you, and from the British people, the significance of a homage to my work during the past twenty-five years on the nature of fermentations, work from which have derived the principles and methods of "microbie", if I may use this expression. In your warm welcome I have re-lived the keen sense of reward which came to me when your great surgeon, Lister, stated that my paper of 1857, on lactic fermentation, had been the starting point of his elaboration of his priceless surgical methods."

Pasteur's lecture was devoted to the theme of vaccination against chicken cholera and against anthrax. "A general principle," he said, "whose fertility inspires me with boundless confidence." "Will you allow me," he said, in conclusion, "before I end, to express to you the deep joy that I feel in thinking that it is as a member of an international medical congress held in England that I have just given you the news of vaccination against anthrax, a disease which is perhaps even more terrible for domestic animals than small-pox for man.

"I have given to the expression 'vaccination' an extension which I hope will be consecrated by science as a homage to the merit and to the vital contribution of one of the greatest of Englishmen, your Jenner. How happy I am to be able to pay tribute to his immortal name on the very soil of this noble and hospitable city of London!"

* * * *

Nearly three years later, in April 1884, the University of

Edinburgh celebrated its third Centenary. The Académie Française was represented by Caro, the Académie des Sciences by De Lesseps and Pasteur.

On April 17, Pasteur received the degree of Doctor *Honoris Causa*.

* * * *

Two years later, in April 1886, the British Government, seeing the practical results of the preventive treatment of rabies, appointed a commission to study and check the facts. Sir James Paget was the President, and the members were Lauder Brunton, Fleming, Sir Joseph Lister, Quain, Sir Henry Roscoe, Burdon Sanderson, Horsley.

Early in July 1887, Pasteur received a copy of the report presented to the House of Commons by this Commission. Over a period of fourteen months the British scientists had checked all the findings which formed the basis of the method. The experimental study made in London, in Horsley's laboratory, had not satisfied them. They had also carried out a long and careful enquiry in France. They had obtained from Pasteur's records the names of ninety people from one region who had been treated, and had seen and questioned them in their homes. "It can be taken as certain," said the Commission's report, "that Mr. Pasteur has discovered a method of preventive treatment for rabies comparable to that of vaccination against smallpox. It would be difficult to over-estimate the value of this discovery, as much from the point of view of its practical aspects as of its application in diseases generally."

On July 4, Pasteur deposited this report in the offices of the Académie des Sciences in Paris. He spoke of the impression of complete and unanimous confidence it gave, and he added:

"Thus all the apparent contradictions have resolved themselves. I am not speaking here of the violent attacks which had as their motive neither any attempt at experiment nor the slightest observation of the findings of my laboratory."

And Pasteur ended with these words:

"During the long course of my scientific career, I have never experienced a happiness equal to that which I felt on reading this report."

* * * *

Five years later, on December 27, 1892, it was Pasteur's seventieth birthday, and his jubilee was celebrated at the Sorbonne. It was a supreme moment. Delegates from the whole world were there to convey to Pasteur the admiration and gratitude of people from the four quarters of the globe.

Among these delegates was one who was dearer than all others to his heart: it was Lister, delegate of the Royal Society.

I still remember, though I was very young at the time, the emotion which swept over the hall when, at the end of Lister's speech, Pasteur rose and embraced the great surgeon who had saved so many thousands of human lives. Was not this gesture a symbol of the bonds uniting our two nations?

In his speech of thanks, Pasteur said:

"You who as delegates of foreign nations have come so far to give a token of your sympathy for France, you bring me the deepest joy that can be felt by a man who is profoundly convinced that science and peace will triumph over ignorance and war, that the peoples of the earth will come together, not to destroy but to build, and that the future belongs to those who have done the most for suffering mankind. I appeal to you, my dear Lister, and to all you distinguished representatives of Science, of Medicine, and of Surgery."

In these few pages I have tried to show how in all his life, from youth to old age, Pasteur was spurred on by the heartening influence of Britain. I have tried to express the sympathy and the admiration which Pasteur felt for the British people.

I sometimes wonder whether the guardian deities of Science had not some secret design in inter-twining the genius of Pasteur with the genius of the great "scientific heros" of Britain, as Carlyle called them. Do we not find the immortal Jenner inspiring Pasteur's research and leading him to the discovery of preventive vaccinations? And the greatest surgeon of all time—Lister—in his turn, inspired by Pasteur's work, devising his antiseptic methods which in the last seventy years have saved millions of human lives? Do we not see to-day, Sir Alexander Fleming and the Oxford scientists bringing to glorious fruition Pasteur's belief in the doctrine of the antagonism of microbes?

This fine instance of scientific co-operation would remind us, should we be tempted to forget, that our two peoples are destined to understand one another, to complement one another and to work together in the intellectual sphere as in all others.

PASTEUR VALLERY-RADOT
Académie Française
Académie de Médecine

I

PASTEUR AS A MAN AND AS A SCIENTIST

Portraits

PASTEUR

Louis Pasteur at the Ecole Normale (1843–1846); in 1853; in 1866; in 1884, at the International Medical Congress in Copenhagen, where he gave an account of his rabies treatment.

HIS MASTERS

J. B. Biot (1774–1862)

J. B. Dumas (1800–1884)

A. J. Balard (1802–1876)

H. Senarmont (1808–1862)

HIS DISCIPLES

E. Duclaux (1840–1904)

J. Raulin, Pasteur's first assistant at the Ecole Normale

Maillot

D. Gernez (1834–1910)

U. Gayon

Grenet

E. Roux (1853–1933)

L. Thuillier (1856–1883)

C. Chamberland (1851–1908)

J. F. Joubert (1834–1910)

Van Tieghem (1839–1914)

E. Nocard (1850–1903)

E. Metchnikoff (1845–1916)

HIS FRIENDS AND COLLEAGUES

Augustin Bertin-Mourot, his old friend, assistant director of the Ecole Normale (1818–1884)

Charles Chappuis, his schoolfellow at the Besançon Collège, and faithful friend

Victor Duruy (1811–1894)

Paul Bert (1833–1886)

Claude Bernard (1813–1878)

Henri Sainte-Claire-Deville (1818–1881)

A. M. Bouley (1814–1855)

J. Lister (1827–1912)

J. J. Grancher (1843–1907)

A. Vulpian (1826–1887)

J. A. Villemin (1827–1892)

J. M. Charcot (1825–1893)

J. B. Chauveau (1827–1917)

G. P. Brouardel (1837–1906)

Towns and districts where Pasteur lived

DÔLE, Louis Pasteur's birthplace (December 27, 1882).
(*Photograph by Jean Roubier*)

ARBOIS, house of Pasteur's father.
(*Photograph by Jean Roubier*)

STRASBOURG, where Pasteur was appointed as a teacher in January 1849, and where he married in the same year, Mdlle. Marie Laurent, daughter of the Rector of the Academy.
(*Photograph by Jean Roubier*)

LILLE, where, as Professor and Dean of the Faculty of Science, he began his study of fermentation (September 1854).

ECOLE NORMALE

(*a*) A. J. Balard's laboratory, where Pasteur, then lecturer-demonstrator, made his great discovery of molecular dissymmetry. The building was pulled down in 1937.
(*Photograph from Doctor Lepine's collection*)

(*b*) Pavilion where Pasteur set up his laboratory in 1860.
(*Photograph by Jean Roubier*)

SALINS, with Mount Poupet (850 m.), where Pasteur made his historic experiment on spontaneous generation (September 1860).

MONTENVERS, where Pasteur continued his experiment.

ALAIS, house of Pont-Gisquet, where Pasteur carried out his researches on silkworm diseases, with Gernez, Duclaux, and Maillot (1865).

LA BEAUCE, near Chartres, where Pasteur, with the help of Chamberland, Joubert, and Roux, started the study of anthrax (Summer 1878).

POUILLY LE FORT, where, at the request of the Society of Agriculture of Melun, Pasteur gave a public demonstration of his method of vaccination against anthrax (May 1881).

VILLENEUVE L'ETANG, an estate granted to him in 1885, to enable him to house his dogs and to carry out his researches on rabies. Pasteur lived there from time to time, and died there on September 28, 1895.

In Pasteur's Country

3 Two general views of Arbois.

4 The bridge over the Cuisance.

5 His father's house, seen from the gardens.

6 The well belonging to the house.

Pasteur's family

7 Drawing of Mdlle. Marie Laurent, at the age of 28, by Adèle Laurent.

8 Portrait of Mme. Pasteur.

9 Mme. Pasteur and her daughter at Villeneuve-l'Etang.

10 Pasteur, at Pont-Gisquet, dictating his observations on the silkworm disease to his wife.

11 René Vallery-Radot, Pasteur's son-in-law and intimate friend, and author of the *Life of Pasteur*.

Pasteur as a sketcher and pastel painter

(*Reproductions of the originals*)

12 His father (pastel).

13 His mother (pastel).

14 Sister Constance Parpandet at the age of 82, formerly of the Order of St. Clare at Poligny, who rebuilt her convent after the Revolution (pastel).

15 Didier Netzler, pupil at the Besançon Lycée (drawing).

16 Jean-Pierre Blondeau, registrar of mortgages, in uniform (pastel).

17 Charles Chappuis (drawing authenticated by Pasteur's father).

18 Lydie and Sophie Roch, of Arbois (pastel).

19 Hortense Pareau (pastel).

Pasteur as seen by the artists of his time

(*Panels and glass cases*)

20 Portrait, by Henner, 1878 (photograph).

21 Pasteur and his grand-daughter, Camille Vallery-Radot. Painting offered to Mme. Louis Pasteur by Mr. J. Jacobsen, a brewer from Carlsberg (Denmark). Bonnat, 1886 (photograph).

22 Pasteur in his laboratory. Edelfelt, 1887 (photograph).

23 Drawing, by Laurent Gsell (photograph).

24 Pasteur and his assistant, by Laurent Gsell (photograph).

25 Plaquette, by Roty, 1892 (photograph).

26 Medal, by Alphée Dubois (photograph).

27 Room in the Académie de Médecine in Pasteur's time (formerly Chapel of the Charité in the Rue des Saint-Pères).

28 Emile Littré, whom Pasteur succeeded at the Académie Française, on December 8, 1881.

Maison natale de Dôle. (Photo Jean Roubier.)

Maison paternelle d'Arbois. (Photo Jean Roubier.)

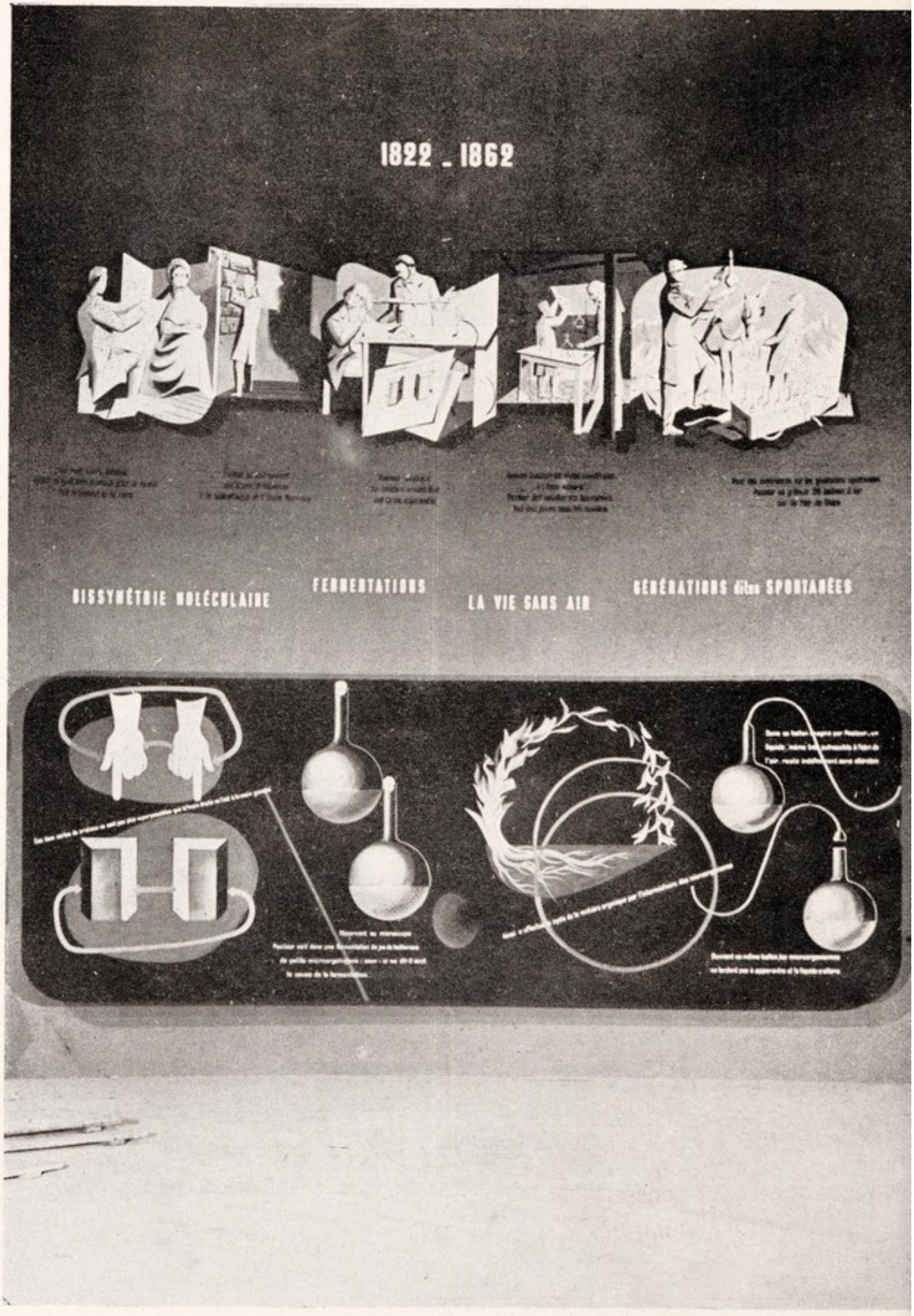
Pasteur élève à l'Ecole Normale (1843-1846).

Le laboratoire de Pasteur à l'Ecole Normale. (Photo coll. Dr Lépine.)

Pasteur en 1853

Pasteur en 1884

Plaquette de Roty; en bas, médaille par Dubois.



Frise d'images et panneau, par Guy Dobignard.

29 Ernest Renan, who received Pasteur at the Académie Française, on April 27, 1882 (photograph).

30 The façade of the Ecole Normale, from 1846 to 1858 (engraving from the *Magasin Pittoresque*, 1851).

31 Pasteur's laboratory (in the foreground) at the Ecole Normale in 1867. The dark windows on the second floor show Pasteur's rooms (from a lithograph).

32 Villa Vicentina, near Trieste, once owned by Princess Elisa Bonaparte. From November 1869 to July 1870 Pasteur directed a campaign there for the breeding of silkworms.

33 Spallanzani, a famous Italian biologist (1729–1799), who was the first to disprove spontaneous generation. Pasteur placed this portrait on the mantelpiece of one of his rooms.

People who had been bitten by dogs waiting to be vaccinated against rabies:

34 In front of Pasteur's laboratory at the Ecole Normale, 1886.

35 In front of the Pasteur Institute, in 1890. Pasteur lived on the first floor.

36 Pasteur, then Director of Scientific Studies at the Ecole Normale, with his assistant director and friend, Bertin.

37 Three of Pasteur's friends: Henri Sainte-Claire-Deville, A. J. Balard, and Ch. A. Würtz.

38 Caricature, by a pupil, showing Pasteur lecturing at Lille; his assistant is standing beside him.

39 Portrait of Pasteur, painted by Frémont (photograph), and Dr. Roux's letter of thanks (December 22, 1922): "It is a perfect likeness of the chief . . ."

(*From the Bibliothèque historique de la Ville de Paris*)

40 Reproduction of the painting by Rixens (1894), representing Pasteur's Jubilee, December 27, 1892.
(*From the Académie de Paris*)

41 Key to all the people who appear in the painting by Rixens.
(*From the Académie de Paris*)

42 M. Pasteur's scientific work. Experiments on rabies in animals.
(*Engraving from the Journal Illustré*, March 30, 1884)

43 Louis Pasteur, original medal by Alphée Dubois. It was presented on June 25, 1882, by J. B. Dumas, in the name of the scientific societies.
(*In the possession of Mme. Henri Braun*)

44 Pasteur, bust, by Paul Dubois. Original *cire perdue*.
(*In the possession of Mme. Henri Braun*)

45 Bust of Pasteur, by Paul Dubois. Sèvres porcelain.
(*From the Manufacture Nationale de Sèvres*)

Pasteur and the popular illustrated press

(*Glass Cases*)

46 M. Louis Pasteur. A caricature in the *Monde Parisien*, December 1863. (*From the Musée Carnavalet*)

47 One of M. Pasteur's experiments. A caricature in colour, priced at five centimes (Pasteur, Rochefort, and de Cassagnac). (*From the Musée Carnavalet*)

48 At the Institut Pasteur, Paris. A caricature in *Der Floh*, Vienna.

49 M. Pasteur in his laboratory. Engraving from *l'Univers Illustré*, 1885. (*From the Musée Carnavalet*)

50 A tribute in verse to Louis Pasteur, with a medallion by Ringel. From *l'Univers Illustré*, 1884.
(*From the Musée Carnavalet*)

51 Louis Pasteur. ''The Glories of the Nation''. Engraving from *l'Univers Illustré*, November 1885.
(*From the Musée Carnavalet*)

52 Louis Pasteur, chemist. Caricature, 1893.
(*From the Musée Carnavalet*)

53 Pasteur. Illustration from the cover of *Médecine Moderne* October 2, 1895. (*From the Musée Carnavalet*)

54 Picture in Epinal style. ''Honours won by France in Peace''. (*From the Director of the Imageries d'Epinal*)

55 Pasteur. Vignette, Félix Potin collection
(*From the Bibliothèque historique de la Ville de Paris*)

II

PASTEUR'S SCIENTIFIC WORK

Autograph letters, manuscripts, and apparatus

56 Two autograph letters from Pasteur to Charles Kestner (a chemist at Thann):

(*a*) February 11, 1849. ''For the last year I have been carrying out some very lengthy investigations on this (racemic) acid. You would be doing me and, I think, science in general, a great service if you would be so good as to send me a few kilogrammes of this acid.''

(*b*) October 30, 1852. On the results of his visit to Germany for the purpose of ''clarifying the question of the origin of racemic acid''.

(*From Mlle. Thérèse Bertin-Mourot's collection*)

57 Autograph letter from Pasteur to A. J. Ba[l]ard, November 1846. His plans for research on amyl alcohol.

(*From Prof. Pasteur Vallery-Radot's collection*)

58 Autograph letter from Pasteur to J. Raulin, dated Paris, March 22, 1863.

(*From Prof. Pasteur Vallery-Radot's collection*)

59 Autograph letter from Pasteur to E. Duclaux, dated October 17, 1866. Apropos of an article for the *Moniteur:* ''. . . may it be a way of reviving my spirit in the midst of the arduous labours of the laboratory and of teaching.''
(*From Prof. Pasteur Vallery-Radot's collection*)

60 Autograph letter from Pasteur to Claude Bernard, dated April 26, 1875. ''The experiment I want to show you is now ready.'' (*From Prof. Pasteur Vallery-Radot's collection*)

61 Autograph letter from Pasteur to Rossignol dated Paris, May 25, 1881. ''We are leaving on Saturday, at 11.55 a.m., to inoculate a very virulent strain of anthrax bacillus . . .''
(*From Prof. Pasteur Vallery-Radot's collection*)

62 Manuscript notes by Pasteur on a study of the nervous disorders produced in a person bitten by a mad cat. By M. Ladame (of Geneva), *Bulletin Médical*, September 4, 1887.
(*From Prof. Pasteur Vallery-Radot's collection*)

63 To Professor Horsley, manuscript draft of a letter from Pasteur (dated August 22, 1886) addressed to the rabies commission appointed in London.
(*From Prof. Pasteur Vallery-Radot's collection*)

* * * *

64 Three flasks used by Pasteur for his experiments on spontaneous generation. The inscription on the label is in his own handwriting: ''1860. Exposed to air.'' The liquid in one of them has fermented.
(*From the Chemical laboratory of the Ecole Normale*)

65 Flask used by Pasteur in his experiments on spontaneous generation. The inscription on the label is in his own handwriting: ''August 3, 1864; Bellevue. Yeast water.'' (Fermented).
(*From the Chemical laboratory of the Ecole Normale*)

66 Flask used by Pasteur for his experiments on spontaneous generation. The inscription on the label is in his own handwriting: ''Mer de Glace. 1 test in room.''

(*From the Chemical laboratory of the Ecole Normale*)

67 Seven bottles containing crystals prepared by Pasteur. The inscription on the label is in his own handwriting.

(*From the Chemical laboratory of the Ecole Normale*)

68 Two models of crystals prepared by Pasteur in support of his thesis.

(*From the Chemical laboratory of the Ecole Normale*)

69 Balance belonging to Pasteur, at Lille.

(*From the Institut de chimie appliquée, Lille*)

70 Microscope belonging to Pasteur, at Lille.

(*From the Institut de chimie appliquée, Lille*)

71 Three flasks sealed by Pasteur (used in experiments on fermentation carried out at Lille).

(*From the Institut de chimie appliquée, Lille*)

72 Theses in Physics and Chemistry submitted by Pasteur to the Faculté des Sciences of Paris, on August 23, 1847, at 11 o'clock.

Chemistry: Investigation of the saturation capacity of arsenious oxide.
Study of the arsenates of potassium, of soda, and of ammonia.

Physics: (*a*) Study of the phenomena concerned in the rotatory polarization of liquids.

(*b*) Applications of the rotatory polarization of liquids to the solution of various problems in chemistry.

(*From M. Charles Dollfus's collection*)

73 Record of the experimental work of first-year students at the Ecole Normale, kept by Pasteur when lecturer and demonstrator there (1847–1848).
(*From the Chemical laboratory of the Ecole Normale*)

74 Record of the experimental work of third-year students at the Ecole Normale, kept by Pasteur when lecturer and demonstrator there.
(*From the Chemical laboratory of the Ecole Normale*)

75 Report addressed by Pasteur to the Minister, on the teaching of the sciences at the Ecole Normale. (He asks for the creation of two lecturer-demonstrator ''agrégé'' posts.)
(*From the Chemical laboratory of the Ecole Normale*)

76 Pasteur's first paper on his discovery of crystalline dissymmetry, presented to the Académie des Sciences at its meeting on October 9, 1848. ''On the relations which may exist between crystalline form, chemical composition, and direction of rotatory polarization'', by M. L. Pasteur, lecturer-demonstrator at the Ecole Normale; Doctor of Science. (*Annales de Physique et de Chimie*, 3rd series, vol. XXIV, 1848.)
(*From the Chemical laboratory of the Ecole Normale*)

77 Pasteur's first paper on ''The method of preventing rabies after the bite'', presented to the Académie de Médecine on October 27, 1885 (*Bulletin de l'Académie de Médecine*, 2nd series, 14, 1885). (*From the Académie de Médecine*)

78 Pasteur's signature when Dean of the Faculty of Science of Lille. Minutes of two meetings of the Council of the Faculty, on March 27, 1885, and December 21, 1857 (Two photographs).

79 From the proceedings of three meetings of the Académie des Sciences: *January* 3, 1853, devoted to Pasteur's work; *December* 21, 1857, paper on alcoholic fermentation; and *May* 30, 1881, observations on the first experiments on rabies. (*From the Library of the Académie des Sciences*)

80 ''Livre d'Or'', from the *Chemical Laboratory of the Ecole Normale.*

81 Attendance register of the Académie de Médecine, page for March 25, 1873, the day of Pasteur's election.
(*From the Académie de Médecine*)

82 Pasteur's tools, kept at the Chamalières brewery at Clermont-Ferrand. On the top shelf, a photograph sent by Pasteur to M. William Kühn ''in memory of my studies at Chamalières, in his father's brewery, in 1871'' (photograph).

83 Binocular microscope purchased by Messrs. Whitbread at Pasteur's suggestion. (*Loaned by Messrs. Whitbread*)

83a 2 models of crystals (Rochelle salt and tartrate ion).
(*From the Dewar Crystallography Laboratory, Chemical Department, Edinburgh*)

Panels

Molecular dissymmetry of natural organic substances (1847–1856).

How Pasteur discovered the following law: ''Molecular dissymmetry establishes what is perhaps the only clear line of demarcation between the chemistry of inert nature and that of living nature.''

Studies on fermentation (1857).

Pasteur discovers that they ''are a life-force''.

Life without air. Studies on putrefaction (1861).

The discovery of anaerobia and the cycle of organic matter.

So-called spontaneous generation (1862).

Pasteur's observations on the source of the micro-organisms causing deterioration in organic matter. ''I claim to prove

absolutely that in every experiment thought to demonstrate the occurrence of spontaneous generation, the observer was the victim of illusions or of causes of error which he either did not perceive or did not know how to avoid.''

Studies on wine and its diseases; vinegar; beer (1862–1871).

Grape-juice fermentation. Pasteurization.

Silkworm diseases: ''Pébrine''. Flaccidity (1865–1867).

Methods of combating these diseases.

The theory of germs: staphylococci, streptococci, pneumococci.

Its medical applications (1877–1880).

The theory of germs: anthrax, vibrio septique (*clostrium welchii*) (1877–1880).

Discovery of the microbes causing these diseases. By applying to contagious diseases the methods he evolved for his study of fermentation, Pasteur establishes the principle of microbiology.

Virus-Vaccines (1879–1883).

Discovered with the co-operation of Joubert, Chamberland, Roux, and Thuillier. Study of the microbes of chicken cholera, sheep anthrax, and swine-fever.

The discovery of vaccination against rabies (1880–1885).

The consequences of Pasteur's work. Pasteur's work revolutionised chemistry, industry, agriculture, surgery, medicine, and hygiene. As the years go by, it will appear greater still because ever more fruitful.

* * * *

Three friezes and three illustrations portraying the life and work of Pasteur. (*By Guy Dobignard*)

Symbolic portrayal of the flowering of Pasteur's work in many different fields. (*By Alain Cornic and Jean Dizambourg*)

III

EXHIBIT BY THE WELLCOME HISTORICAL MEDICAL MUSEUM

84

(*a*) **Early work: the foundations of stereochemistry (1847–1856).**

When Pasteur began his work it was known that there was a connection between the form of the crystals of certain substances and their effect on light which has been passed through a polarimeter. Pasteur showed that if a solution of a salt of racemic acid was allowed to crystallise slowly, two types of crystals were obtained. One type had facets on their left side; when these were dissolved, the solution rotated the ''plane of polarization'' to the left. The other type had facets on the right, and in solution they rotated the plane to the right. These results had very important effects on the development of our knowledge of crystals and of the molecular constitution of matter.

(1) Crystals prepared by Pasteur showing the relationship between this effect on polarized light and the form of the crystal.

(2) Crystals prepared by Pasteur from tartaric acid and various alkaloids. By the difference in the solubility of the tartrates formed, Pasteur was able to resolve paratartaric (racemic) acid into its constituents.

(3) Crystals of l-ammonium tartrate (rotating the plane of polarization to the *left*) obtained by Pasteur by fermentation of ammonium racemate.

(4) l-tartaric acid (rotating to the *left*) obtained by conversion of d-tartaric acid (rotating to the *right*).

(5) Specimens prepared by Pasteur during investigations into the optically active and inactive forms of amyl alcohol.

(6) Facsimile of models of crystals made by Pasteur.

(*b*) **The overthrow of the doctrine of spontaneous generation (1860–1864).**

Micro-organisms constituted the last stronghold of the theory of spontaneous generation, which had held the field since the time of the ancient Greeks. Pasteur disproved the universal belief that an infectious disease could arise without a pre-existing case.

(1) Microscope used by Pasteur in this work.

(2) Apparatus used by Pasteur in preparing flasks of liquids. (Facsimile of the original in the Institut Pasteur.)

(3) Flasks of liquids prepared by Pasteur, showing the effect of dust-contaminated air, and of heat, on the development of micro-organisms. (Facsimiles of originals in the Institut Pasteur.)

(*c*) **Studies on the fermentation of vinegar, wines, and beer (1862–1871).**

Pasteur showed that alcoholic fermentation occurs as a result of the life processes of the yeast cell, and that the deterioration and spoiling of wine and beer is due to the development of other organisms.

(1) Apparatus to show the absorption of oxygen during acetic fermentation.

(2) Flask designed by Pasteur to show the absence of alcoholic fermentation during the aërobic growth of moulds.

(3) Flask designed by Pasteur to show the presence of alcoholic fermentation during the anaërobic growth of moulds.

(4) Apparatus for the examination of organisms present in liquids.

(5) Pasteur's prototypes of apparatus for the sterilization of wines.

(6) Pasteur's prototypes of apparatus to maintain the purity of wort and yeast during the manufacture of beer.

(7) Tubes of wine prepared by Pasteur showing that the maturing of wines is due to oxidation.

(No. 4 is the original used by Pasteur; Nos. 1–3 and 5–7 are facsimiles of originals in the Institut Pasteur.)

(*d*) **Pasteur's application of his methods to the prevention of diseases (1865–1895).**

(1) Microscope used by Pasteur in researches on silkworms.

(2) Silkworms and cocoons collected by Pasteur.

(3) Pipettes used by Pasteur in experiments on rabies.

(4) Filter used by Pasteur and Chamberland in work on anthrax and chicken-cholera.

(5) Pasteur's cultures of vibrio septique.

(6) Alkaline urine used by Pasteur as culture medium for the anthrax bacillus.

(5 and 6 are facsimiles from the originals in the Institut Pasteur.)

(*e*) **Two laboratory note-books of Pasteur, in his own handwriting.**

(1) Note-book written by Pasteur in 1847.

(2) Note-book dealing with chemical lectures at the Collège de France.

(*f*) **Original manuscript of Pasteur's paper on** *The growth of crystals*, **1856.**

(*g*) **Six autograph letters of Pasteur to his assistant, Dr. Jules Raulin.**

(1) Letter dated November 23, 1867, referring to his new laboratory.

(2) Arbois, October 20, 1870, written during the Franco-Prussian war, when the Prussians were nearing Paris.

(3) Clermont, May 11, 1871, on methods for the large-scale production of yeast.

(4) Paris, August 22, 1871, referring to his work on silkworms and to his approaching visit to England.

(5) London, September 9, 1871, describing his visits to the breweries of London.

(6) Arbois, September 7, 1874, dealing with experiments on yeast.

(*h*) **Note in Pasteur's handwriting for M. Mischet.** Dated August 31, 1883, on vaccination against swine fever.

(*i*) **Letter of Pasteur to Eugène Viala, his assistant at the Institut Pasteur.** Dated September 12, 1883, giving instructions for experimental work on rabies.

(*j*) **Printed works of Pasteur.**

(1) "Recherches sur les relations qui peuvent exister entre la forme cristalline, la composition chimique et le sens de la polarization rotatoire" (1848). (Pasteur's autographed presentation copy to M. Elie de Beaumont.)

(2) "Mémoire sur les acides aspartique et malique" (1852). (Pasteur's autograph presentation copy to M. Elie de Beaumont.)

(3) "Mémoire sur les corpuscules organisés qui existent dans l'atmosphère". (Pasteur's autograph presentation copy to M. Raulin.)

(4) "Etudes sur le vin, ses maladies, causes qui les provoquent, procédés nouveaux pour le conserver et pour le vieillir" (1866).

(5) "Etudes sur la bière" (1876).

IV

THE PASTEUR INSTITUTES OVERSEAS

(The dates give the year of their foundation)

African Institutes

FRENCH NORTH AFRICA

Tunis, 1893.
Algiers, 1910.
Tangiers, 1913.
Casablanca, 1932.

FRENCH WEST AFRICA

Saint-Louis in Senegal, laboratory of microbiology, 1896; transferred to Dakar, 1913.
Bamako (Sudan). Institute of leprosy, 1920.
Kindia (Guinea), 1923.

FRENCH EQUATORIAL AFRICA

Brazzaville, 1908.

MADAGASCAR

Tananarive, 1927.

Asian and American Institutes

INDOCHINA

Saigon (Cochinchina), 1891.

Nhatrang (Annam), 1895.

Hanoi (Tonkin), 1925.

Dalat (Annam), 1930.

Public health laboratories:

Phom-Penh (Cambodia), 1913.

Hué (Annam), 1910.

Vientane (Laos), 1919.

CHINA

Shanghai, 1938.

AMERICA

Fort-de-France (Martinique), 1939.

Cayenne (Guiana), 1940.

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Diorama: Old and new buildings of the Pasteur Institute at Brazzaville.

Dioramas: Various stages in the manufacture of anti-plague sera and vaccines at the Pasteur Institute at Nhatrang. Model figures made by the native workers of the Institute, showing themselves engaged on their everyday tasks.

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Frieze of pictures and panel illustrating the work of the Pasteur Institutes abroad. Views of these Institutes.

(*By Guy Dobignard*)

The various activities of the Pasteur Institute of Paris since the death of its founder (large picture).

V

SOME OF PASTEUR'S PERSONAL BELONGINGS

(From the Institut Pasteur, Paris)

85 Dress worn by Pasteur as member of the Académie des Sciences.

86 Sword and hat worn by him as a member of the Académie des Sciences.

87 Hood worn by him as Doctor Honoris Causa of the University of Edinburgh.

88 Blotting-pad bearing the initials L.P.

89 The Rumford Medal.

90 Reproductions in colour of pastels of Pasteur's mother and father.

91 Two models, in wood of tartrates.

LIST OF ILLUSTRATIONS

Plate

Designed and printed by Lund Humphries, London and Bradford
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