

THE MICROBE MAN

A LIFE OF PASTEUR FOR YOUNG PEOPLE



by ELEANOR DOORLY

Illustrated by ROBERT GIBBINGS

INTRODUCTION BY PROF. PASTEUR VALLERY-RADOT

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A Life of Pasteur for Young People

by
ELEANOR DOORLY

AUTHOR OF "THE INSECT MAN"

Introduction by
PROFESSOR PASTEUR VALLERY-RADOT



Woodcuts by ROBERT GIBBINGS

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To

WALTER DE LA MARE

“Who is the greatest man?” asked the Riddler.

And the Statesman replied: “He whose work endures longest and spreads farthest and brings most joy to the greatest number of mankind!”

“The Poet, then, or the Healer?” laughed the Riddler.

INTRODUCTION

PASTEUR loved young people. “When I meet a child,” he wrote, “he arouses two feelings in me: tenderness for what he is now, and respect for what he may be in the future.”

Pasteur would have been glad to have his story told to English children, whose country he admired more than any other, by Miss Doorly, who has known how to bring out all the great lessons of his life.

“My work, my family, my teachers, my country, those are the things I have always loved,” he said. Miss Doorly’s vivid book is the paraphrase of that saying.

After they have read these pages, the young compatriots of Jenner and Lister will know the debt that humanity owes to the man who discovered the world of the *infinitely little*.

Professor PASTEUR VALLERY-RADOT
Member of the Academy of Medicine

PASTEUR aimait les enfants. “Quand j’approche d’un enfant,” écrivait-il, “il m’inspire deux sentiments: la tendresse pour le présent, le respect pour ce qu’il peut être un jour.”

Il lui aurait plu que son histoire fut racontée aux enfants d’Angleterre, de ce pays qu’il admirait entre tous, par Miss Doorly qui a su mettre en lumière toutes les grandes leçons émanantes de sa vie.

“Mes travaux, ma famille, mes maîtres, ma patrie, voilà bien ce que j’ai toujours aimé,” disait Pasteur. Le livre si vivant de Miss Doorly en est la paraphrase.

Après avoir lu ces pages, les enfants du pays de Jenner et de Lister sauront quelle reconnaissance l’humanité doit à celui qui découvrit le monde des *infiniment petits*.

AUTHOR'S FOREWORD

INSTEAD of telling the tale of Pasteur within the cover of a book, I should have liked to take you, boy and girl, on the journey I made in France to look for France's great man. But happily there is nothing to prevent your taking yourselves either in your father's car or on foot with a knapsack on your back. But if you haven't French on your tongue, put it there as quickly as possible, for France likes you and longs to talk to you and to give you with open hands the freedom of all her lovely possessions.

In silence, or in English, of course you can ski on her snow mountains and swim in her warm Mediterranean and both on the same day. In silence or in English you can enjoy her road avenues of flowering fruit trees, or scented violets from her hedges which are blue and white with them. In silence or in English you can gaze with wonder at her lovely buildings and explore her deep and winding gorges. But if you speak French, even a little, even badly, France loves you and you love France and then the fun begins and never grows less. So here is the tale of how this book was written.

The little car came out of the long avenues of pear blossom into the Square of Dole, and, almost before she drew up, a small boy in uniform was standing on the running board, telling us where to stay, and he could not have told us better. After dinner, under the moon, we wandered out into the unknown town and found Tanners' Street and the house where Pasteur was born. Then we leaned on the bridge and watched the great dark Doubs that soaked his father's tan. And the next morning, inside the house, a friendly housekeeper showed us Pasteur's own treasures and invited us to stay a month, not a day.

Then we wandered to Marnoz among the hills, where a delightful and famous vintager helped us to peer among her palms for paintings on hidden doors and gave us the most sparkling of all wines to drink. And when we came to Arbois, not only was there Pasteur's house to see just as he had left it, with even his bread basket standing beside his chair, but a passer-by looked in through the roof of the car and there and then told us all the tales of Pasteur we might wish to know and directed us to each spot where things happened.

At Lemuy all the old ladies turned out to tell us the way to the mill and then, realizing that we were always lost at every opportunity, forced the other passengers to get down, while they got up to drive to the exact spot.

But even that was not as gay as stopping in the middle of an empty village and asking the only man visible if he could tell us how to meet the pigs of Bollène, because Pasteur had been acquainted with them. He was a famous restaurant keeper from Paris, at home on holiday, and was delighted to introduce us to our pigs and to show us his collection of old furniture and to inveigle us to visit prehistoric villages.

So we went on to climb the Cevennes, gathering narcissus and stepping uninvited into a farm where a silkworm grower was actually feeding her silkworms. She taught us all about them, and when we wanted to give her a gift for her trouble, refused, but made us instead sit down to elevenes of home-made liqueur and cakes.

Then crossing the roof of France in winter, though it was called spring, we came to Chamalières and asked first of an intelligent passer-by what the French called a place that made beer. “Brasserie,” she answered. And armed with the word, we inquired our way. Perhaps you guess that it is a drink shop as well as a brewery. But we found the brewery where Pasteur had worked, for even the lorry drivers knew about him and no one inside was too busy to praise him and to teach us how beer is made.

And later on, after many other places, we came to one of the villages called St. Germain and said timidly to a girl: “Can you tell us if this is the St. Germain to which Pasteur came?”

“Oh yes,” she replied, “that is his farm beyond the pond.” And we must needs meet all the animals and take their photographs and hear more tales of Pasteur and be given sweets and taken to see a dear old lady who had cooked for him.

By that time we thought that we had surely exhausted our luck. But the best was to come, for the great doctors of the Pasteur Institutes were even more eager and more kind than the peasants of France in telling us about Pasteur.

I would like here to express my warm gratitude to Pasteur’s grandson, Professor Pasteur Vallery-Radot for his great help, for his permission to make use of his father’s book and to reproduce Edelfelt’s portrait, for reading my manuscript and for his generous words of introduction to my book.

I would like also to thank the other Pasteurians, who, out of their love for their great predecessor, gave me so much of their valuable time: Dr. Ramon, Director of the Pasteur Institute at Garches, himself the discoverer of the diphtheria anatoxin; Dr. Goldie, who taught me as only the lucky are taught; Dr. Martin and Dr. Legroux of the Pasteur Institute in Paris. I owe

them all a debt that only your interest, boy and girl, in the Story of Pasteur can repay.

The matter of this book has been taken, by permission, as any life of Pasteur must be taken, from *La Vie de Pasteur*, by René Vallery-Radot.

CONTENTS

	PAGE
INTRODUCTION BY PROFESSOR PASTEUR VALLERY-RADOT . . .	<u>viii</u>
AUTHOR'S FOREWORD.	<u>ix</u>
CHAPTER	
I. UNKNOWN	<u>1</u>
II. GROWING	<u>9</u>
III. REVERSE AND RECOVERY	<u>22</u>
IV. CRYSTAL CLEAR.	<u>32</u>
V. A SEARCH	<u>42</u>
VI. THE GREAT DISCOVERY	<u>50</u>
VII. GOLD TREES.	<u>67</u>
VIII. WAR	<u>83</u>
IX. A PROPHECY FULFILLED	<u>90</u>
X. UNHAPPY BEASTS	<u>96</u>
XI. A LUCKY MISTAKE.	<u>106</u>
XII. ACCLAMATIONS.	<u>114</u>
XIII. MAD DOGS AND OTHERS	<u>124</u>
XIV. JOSEPH AND JUPILLE	<u>136</u>
XV. THE CROWD AND ONE	<u>144</u>
XVI. EVERYWHERE ALIVE	<u>154</u>

THE MICROBE MAN



CHAPTER I

UNKNOWN

THEY called him Louis. He was nothing but a funny, red, crumpled-up thing like any other boy baby, when he opened his eyes for the first time in Dôle. It was winter outside, the kind of winter you get when the Alps are quite close to you and the East wind races away from them over your little plain and across your great river.

His mother looked at him a long time and his father too, because fathers and mothers always do that. Then the right people wrote in the town book that it was at two o'clock in the morning of December 27, 1822, that he was born, and that it was five o'clock in the afternoon when they were writing down the fact; and that his father's name was Jean Joseph and his mother's name, Jeanne Etiennette. But, however they looked and whatever they wrote, there wasn't one of them, no, nor anybody else, who saw anything different in him from any other boy baby. You couldn't look at him and imagine he was going to be anything great, anything exceptional or out of the ordinary. Why, his very house would have told you not to do that.

It was an ordinary little house, in an ordinary little street, and it belonged to a man who followed the very ordinary trade of tanning leather for boots and shoes or anything else that's made of ordinary leather. Just notice that

nobody said it was an ordinary man that owned the house. A man is one thing and his trade is another. The most important part of Jean Joseph's house was the cellar, a two-roomed cellar. The right-hand room was full of round and square ditches filled with strong-smelling tan and the left-hand room was full of deep vats where the leather soaked, while the river flowed right up to the house wall itself to do the soaking.

Above the cellar was Jean Joseph's workroom, full of his big wooden tools and above that again were two little rooms side by side and a little back room. That was all—a little ordinary, poor house where Louis was beginning to make acquaintance with this extraordinary world so cram full of kings and counts and castles and generals-in-chief and lord-high-admirals and philosophers and financiers and all kinds of people who might have had a baby who became famous. But they didn't! While this tanner's son. . . ! But we mustn't get on too fast.

Eighteen days later, they took him along Tanners' Street, up the long flight of steps that did instead of the next street, to his christening in Dôle Church. No doubt he yelled like any other well-behaved baby to let the devil out when the Holy Water touched him, though nobody has thought it worth while to tell us anything about that. There were probably lots of people passing by in the streets, for Dôle was a busy, pleasant little town, but not one of them thought about getting out the decorations, or the flags, or the town band, or even ringing a joy peal on the church bells as they certainly would have done if it had been a Louis for King Louis XVIII.

If the vine-dressers passed by, they only looked at the sky and wondered if the winter would be bad for the grapes. Little did they suspect what that baby was going to do for them.

And the women, who stood in their doorways, why should they look at other people's babies? Babies were common enough! And they died in shoals, too. Couldn't any one tell you tales of how the little things caught a sore throat, called diphtheria, and died, whole families at a time? And the mothers died, too. It was just luck if a mother didn't die when her baby was born. And how could any one imagine that that crumpled-faced thing would. . . ?

And the farmers, grumbling to one another about how this one had lost all his hens of chicken plague and that one was ruined outright, because his oxen had wandered on to the "accursed land" and died in a night, as oxen did in those days—they never paused in their complaint about farmers' bad luck to say: "There he goes, the future great man, who. . . !"

And the rich silk merchant, driving by in his coach and six on his way to the silk city of Lyons, wouldn't so much as know that he had passed a baby who was going to give him back his horses and his wealth one day when he thought he had lost them for ever.

And the old men weren't much wiser. They looked perhaps and turned away saying: "Boy, isn't it? If boys are not killed in war, they die of wounds or a little scratch got climbing a tree." For boys used to die then of a mere broken leg. And in war, far more died of wounds or sickness than were killed in battle. No, those old men wouldn't suspect that baby either; but just go on telling tales of how such a one had died in terrible torture because a mad dog had bitten him; and of how the country was full of mad dogs and all the children terrified if they did but see a thirsty dog running down a street; and of how it was a danger to life to let a mere pet dog lick your hand, because you never knew what would come of it. One would have thought, since they were interested in mad dogs, that they would have seen something odd about that thumb-sucker! But they didn't.

And so far, there was nothing odd to see about him. His mother, the gardener's daughter, and his silent soldier-tanner father loved him; and his sister looked curiously in at his cradle and whispered "Louis! Louis Pasteur!" and he didn't even answer to his name yet, as a puppy might have done.

Like any other baby, he was crawling next, and walking after that and learning to talk the French tongue and perhaps getting the grammar of it right and perhaps wrong.

But if baby Louis was as yet nothing out of the ordinary, there were two people at number 43 Tanners' Street, who were not common at all, and those were Jean Joseph and Jeanne Etiennette. If you want to know anything about a baby, you must know something about its father and mother, because they have to bring it up. Jean Joseph was a good tanner; he didn't mind how much trouble he took to make his leather the best possible, and *that* is not ordinary. But there was more in him than that. He didn't belong to Dôle. His family came from little villages high up in the Jura Mountains where piercing winter from the Alps holds the land for most of the year and the wind, even in May, is strong enough to blow the horns off an ox, as the French say. There men grow stubborn and strong and faithful, and love their harsh Forest of Joux that shows soft and purple in the distance. And there the ground is crowded with intense, tiny, blue gentian flowers, who seem to say that the brightest colors come from harshest living.

All Jean Joseph's family had been peasants—millers, plowmen, and tanners. It wasn't so long since they had been serfs, belonging to the land of

Lemuy and sellable with it, like the oxen, whensoever Count Adressier, Lord of Ecleux, of Cramans, Lemuy and other places, so willed. Jean Joseph's grandfather, it was, who bought his freedom, paying four pieces in gold of twenty-four livres for it. He became a free man and able to leave the mill at Lemuy. That was in the year 1763, only fifty-nine years before Louis' birth, and you can still see the ruins of the mill on the cold windy heights among the gentians.

Perhaps, from him, Jean Joseph inherited a love of freedom and independence to give his son.

Before he was a good tanner, Jean Joseph had been a good soldier of Napoleon. What a life he had had! What things he had seen! He had well-nigh worshiped his Emperor and had gloried in his victories. He had fought a most exciting war among ambushes and surprises in the Spanish mountains and had broken his heart over Napoleon's defeat and banishment. With despair sitting heavy on his steps, he had walked away disconsolate from his regiment home to Salins to be a tanner. He was a quiet, silent man; but there were things that could rouse him. One day the Mayor told him to take his sword to the Town Hall. He obeyed, thinking it was going to be kept safely. But when he saw that the loved emblem of his service was going to be given to a mere policeman, he seized it back again. The crowd understood and suddenly became dangerous. No one dared to take the sword from Jean Joseph. In triumph the crowd escorted him and it home. There was quite a stir in Salins; the tanner had defeated the Mayor.

Though Jean Joseph was somewhat of an artist, he probably did not notice what a beautiful picture was always before him when he looked out at his own back garden. His house is still there for you to visit, with the little River Furieuse flowing between gardens at the back. In the garden on the other side, walked and worked Jeanne Etienne Roqui, and it wasn't long before she was carried off to Dôle to become the mother of that same Louis.

Now, "to love like a Roqui" was a proverbial saying of those parts; so you won't be surprised if Louis, as he grows up, loves . . . well! . . . like a Roqui; and is as good a worker, as ready to serve France and as fiery in defence of what he honors as . . . as a Pasteur!



CHAPTER II

GROWING

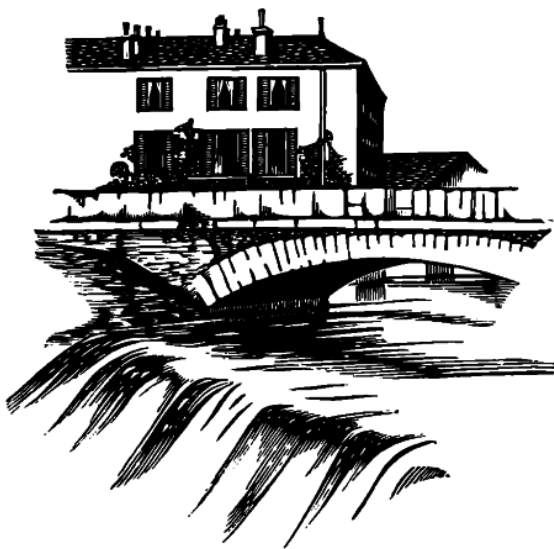
LOUIS was a little more than three, when on a fine morning, or it may have been wet, for no one has told us anything about the weather of it, Jean Joseph and Jeanne Etienne piled their furniture and their wooden tools and Louis and Antoine and baby Josephine into a big creaking cart and set out to live in a house at Marnoz that grandmother Roqui had given them.

The road was long and rutty. We shouldn't call it a road at all nowadays. Through the Forest of Chaux they went, and along by the apple orchards, past hillsides covered with vines from which came bright, sparkling wines, till, late in the day, they came to little, hilly Marnoz in the pear orchards, with rugged Mount Poupet beyond.

And there, by the roadside, was grandmother Roqui's little house. But no one knows what Louis thought of the new home because he hasn't told us; and we can't even know what we think ourselves, because, although the house is there still and very pretty and flower-bedecked on the outside, part of it has become just a conservatory where delicate palms are piled in winter, and part is a lodge to a great wine cave, where the sparkling wines sleep and are shaken awake every single morning till they mature.

But it was in that house that Louis first remembered himself. He remembered that he had friends and that he used to run out and play with

them along the little country lane that leads to Aiglepierre. By then, he must have been a sturdy little fellow with gray-green eyes that looked at you steadily and intensely. There's a door in the house, that you can peer at through the palm leaves, but scarcely see, which Jean Joseph one day used as a painting board. The picture he painted was of an old soldier in a blue uniform—old, that is, only in the sense of not-a-soldier-any-more. That soldier, like Jean Joseph himself was leaning on a spade, with his eyes full of regretful dreams, longing to be a soldier again, or perhaps only longing for the days of the glorious Emperor to come once more. Perhaps Louis looked with admiration at his father's painting and wanted to play with the paints and make pictures of people, too.



Then, because the tiny stream of the place was not good for tanning, they had to move again. Up the hill to Aiglepierre, through the little lanes, out to the high road to Arbois, they drove.

There in front of them lay the little town among the trees and hills, with its square-towered church high above the brown roofs and tall poplars, like pikemen, guarding the entrance.

With what excitement the small boy and his sisters went for the first time into their new home! It was just over the bridge at the beginning of the town. The little Cuisance splashed and roared in a waterfall underneath the bridge, and then, in quieter mood, slid along the wall of the house. There was a garden in front and the door opened into a passage, on the left of which was the shop, where Jean Joseph could keep his tanned leather and do his selling.

Farther in, was the bake-room where the family would bake their own bread. On the other side was the dining-room and another little room opening on to the courtyard where Jean Joseph would make his ditches for the tan. An outside door led straight upstairs to Louis' room and his father's workshop and there was a ladder to the loft. That house was to be Louis' "always home," and to grow with him into the lovely old white house which welcomes visitors to Arbois now.

That Cuisance was a delicious river for a small boy. It was broad and noisily pebbly and it had fish in it. Louis had soon collected friends, Jules Vercel and other small boys. Together they wandered along the stream into the fields where the wild tulips grow on the banks; and in any likely place, they were soon hanging a bait into the water for the exciting business of a catch. But when it came to bird-snaring expeditions, Louis held back and wasn't anywhere to be found. He was too tender-hearted to see a bird hurt.

He was eight when there was a great stir in Arbois. Great things were happening in far-away Paris. The King, Charles X, had suddenly sent forth *ordinances* depriving the people of some of their liberty and making himself what now we should call a dictator. Paris would have none of it, barricaded her streets in one July night and prepared to fight for liberty. The citizens of Arbois swarmed into their streets like angry bees, talking, discussing and ending by sending a message of encouragement to Paris: "All Arbois is ready to fly to the help of the Parisians!" No doubt, Louis took note that however distant and insignificant one may be and however unasked one's help, it is well "to do what one can."

When he was nearly nine, he had a new adventure. Up Courcelles Faubourg, under the deep shady arcades, past the big square, he went with the other boys to the infant school attached to the big boys' College.

So the schoolmasters began their work of teaching Louis Pasteur. Did the angels in heaven have a good laugh at the thought? "Teaching Louis Pasteur!" The schoolmaster set the bigger boys to do it. They showed the little ones the letters and then the whole class spelt aloud, making a splendid—or a horrible noise, while the master went his round, picking out the most likely boy here or there to be a monitor and keep the rest in order. Louis was the smallest there, so he especially longed to be a monitor.

He made progress too—not exceptional progress. He just got on quietly learning what there was to learn. He bought a lesson book when he could and was proud to possess it and to write his name in it—a splendid possession, his own property. Lesson books were heavy and ugly enough in those days—no pictures and decorations and nonsense rimes and stories doing instead of work, as nowadays! Not a bit of it! Hard, solid, ugly, real

things, those books. They are still at Arbois, in Louis' bookcase for any one to see. "If you want learning," they seem to say, "well, want it! Take it! Pleasant? Who talked of pleasant? Easy? Ha! Ha! Ha! No Homework? Hum!"

Louis took his books home to his father, who hadn't more of learning than would let him write his name or keep count of his skins and payments, and they did their lessons together, working hard. They were real companions, father and son.

Louis brought things into the house which his father had not thought much about up to then: friends, books, ideas. Even in the matter of painting pictures, Louis was showing a skill his father had never possessed and could paint people just like the life. Was he going to be an artist? He was showing no sign of taking to tanning, though a fair living was coming in from the old business all ready to make an only son a prosperous man.

When he was twelve, another stirring event happened in Arbois. One dark night, there was news that a coach with lights and steaming horses had stopped in the square up the street and that a passenger was giving out exciting tidings: "Lyons, the great city had declared a Republic!" Newspapers were rare; any rumor had a long start on the truth. The men of Arbois were delighted. They determined to rise in revolt. The vine-dressers hurried to the Town Hall and seized the guns. Every one was a-buzz. But it wasn't long before another rumor was spreading, true this time. The Grenadiers, the Chasseurs, the artillery were marching and lumbering down the winding road through the hills from Besançon to Arbois. Louis was out like everybody else to see the show; weren't there real cannon rumbling over the Cuisance bridge in front of his very house? "Who is leader?" asked the prefect of Poligny, the lofty city on the rocks to the South.

"We are all leaders," answered the bold men of Arbois. They were like that.

But the next morning the Paris newspapers announced: "Arbois, Lyons, and Paris are calm." Perhaps the school-boy Louis asked some questions about the why and wherefore and meaning of a Republic and the calling out of troops. He was finding history interesting and feeling himself an Arboisian, one with the fine fellows who held the town for three days in the time of Henry of Navarre, against an army of 25,000 men. Where he could get a tale of the great past of Franche-Comté—the wide hill district of the Jura—he loved it, he felt his country tugging at his heart and began to glory in his country. And he couldn't be the son of one of Napoleon's sergeant-majors without setting the great Emperor above other men. So he was beginning to have opinions of his own.

A year passed. He was thirteen. What was he going to be? He was almost grown up. He should do just as he liked, said his father, and have better chances than he himself had had! What would have become of you and me and France and the poor world, if Jean Joseph and Jeanne Etiennette had been the kind of people who say: "My son must earn quickly"! They didn't say anything of the sort. They let him paint. There are lots of portraits of his doing for you to see for yourself what a good painter he would have made. They are not childish work. In pencil or charcoal or oils, Louis was making a name for himself. He used his eyes, saw just how the line went, saw the expression of a face and the clothes that suited, caught the sitter at the right moment. There is a portrait of his mother, for instance, going to market in her blue and green shawl and her white cap and that calm, yet eager expression of hers; another of his father, a little melancholy, secret, reserved, thinking. It must have been exciting to have a budding artist in the family and people coming along to have their portraits painted. Nothing is more exciting than to see a likeness growing on paper. He was only thirteen. There was time.

Louis was among the bigger boys in the College itself by then. His headmaster wrinkled his forehead sometimes as he looked at him.

"Was there something exceptional about that boy? No! Just one of the ordinarily good!"

But "Yes! With what undisturbed concentration he read!" His head never lifted for any noise of other people's laughter or disputes or play; buried in whatever he was doing, he was. But still only ordinary, carrying away the prizes when they came his way, but not doing anything striking. Still, Headmaster Romanet noted that the boy's slowness came from a desire to think before he answered, to be sure that he was sure, before he spoke. Romanet walked with him in the sunny, dusty courtyard under the plane trees, stirring his thought, putting ambitious ideas into his head about Paris and her great schools, taking note that the boy's eyes flashed with eagerness though his tongue said little.

A tanner's son of the remote Jura, where should he find the money to journey so far and to live in Paris? Every ambitious French boy wants to enter the École Normale or the École Polytechnique. They are famous schools—more famous even than the Sorbonne, which is the University of Paris, because it is harder to get into them. They are magic names. In Romanet's talk, Louis began to hear the words École Normale with listening ears, began to dream of taking a place among the first in France. Would he? Had he the brains to enter there? Under the planes, the boy's eyes shone.

In the quiet, reserved home, a sort of stir began. École Normale! École Normale! Whether the words were spoken or not, they were there at the back of every one's mind. Quiet friends turned them over in conversation. The schoolmaster sat silent, smoked, and thought them. How *could* Louis go there? The long journey . . . the expense! The wild and shocking ambition of such an idea! "No!" said Jean Joseph. "Let the boy go to Besançon to study, only a day's journey, and then come back to teach in Arbois. Wouldn't that be grand enough?"

"It's not so difficult as you think," suggested Captain Barbier, who was spending a holiday out of Paris in Arbois. "There is a Franche-Comtois, who has a school in Paris, who would take the boy cheap and prepare him for the École Normale, for love of Franche-Comté."

That was how it happened. Jean Joseph and Jeanne Etienne had decided to pay their price. They counted over the money carefully, counted the sadness of parting with the boy, counted the dangers of dangerous Paris—and he was not yet sixteen! But they reflected that Vercel was going too—two boys would be safer than one alone and Vercel would take care of Louis. Vercel was so sure of Louis' great future. Moreover, Captain Barbier would give the boys an eye. Certainly the money was the least part of the cost of this chance the boy was getting! But he was to get it. His father and mother were brave to endure pain and anxiety.

Probably no one suspected the price the boy himself would pay for his learning.

The skies were not going to help. On the October morning when he started, it rained, it sleeted, the bitter Jura wind drove occasional snow flakes in their faces. The lumbering coach looked full already as the restless horses, resentful of the cold, were coaxed into the shafts. The two boys had the most uncomfortable seats on top under the tarpaulin, behind the driver, for all the inside seats were taken and those under the driver's hood also.

Louis had not realized till then what it would mean to say good-by. A cold, worse than the cold of the elements, took hold of him. What would it be like, evening after evening, without coming home? The horses were really moving. His people were standing there in Arbois' rain and he was moving with creak of wheels and jingle of harness out of the courtyard of the Hotel de la Poste. Down the boulevard Courcelles, past his very own door, over the Cuisance, not to the right this time, the road of his walks with his father, but to the left—to Dôle.

Faster and faster the horses went. In the misty rain, Arbois and its square tower were quickly out of sight; and Louis realized, perhaps for the first

time, that he was a desperate home-loving boy. At Dôle he was too sad to notice that he had returned to his birthplace. In the long, strange plain that the Doubs makes, he must have seen, without noticing it, utter, complete flatness for the first time in his life. He took, they say, no note of stopping places save as pauses to change horses. Yet they passed through towns great in history: Dijon, with its mighty Ducal palace, Auxerre with its magically lovely Cathedral, Sens, with its medieval minstrel, Fontainebleau with its enchanted forest and its palace, dreamily watching itself in still waters and brooding over its sad memories of Napoleon's abdication. To Louis, they were all only notches in the gray miles of distance from home.

Two shivering shrimps of school-boys on the top of a coach in the rain! and the splosh, splosh of the post-horses' rapid feet in the mud! What drenched passer-by, as he stood aside to escape a splash, could have guessed that all the world's sorrow was growing less because two white horses and three brown were galloping Louis Pasteur toward Paris?



CHAPTER III

REVERSE AND RECOVERY

It was Paris at last—a strange sight for a boy of sixteen, who, except in coaching through them, had seen no town bigger than little Arbois. Neither was his first sight of Paris the Paris of dreams, the gay Paris of the wide, leafy avenues of the Champs Élysées and the splendid shops of the rue de Rivoli and the more splendid palaces of the Louvre and Tuileries. The coaching road from Fontainebleau ran in on the south side of the Seine, through mean and busy streets, between high, oppressive houses. It is true that in that quarter—the quartier Latin as it is called—every other stone reminds us of some glamorous history and that all the learning of Paris is gathered there; but to the school-boy from the Jura, those things meant little.

Impasse des Feuillantines, where he was to stay, may not have been a slum then as it is now; nor Pension Barbet quite so dark and dreary-looking as the elementary school that now stands in its place; but there is nothing to suggest that they had anything to catch a boy's interest or to wean him from his longing for bright, gay Arbois and its turbulent fish river. A narrow street with a way in but no way out, tall, drab houses all alike, approached by interminable streets must have seemed like a prison or a frightening maze to the country boy. Home was in another world, cut off from him for ever by a journey which was so long that it seemed it never could be re-made. It is not easy for us, to whom travel is common, who go home for every holiday, to slip under the skin of a school-boy who had made his first immense journey and found himself imprisoned in the maze of Paris.

Such a price to pay for learning! Had he abandoned his home for ever? There seemed to be no remedy. Dutifully, each day, he went down the boulevard St. Michel to the Lycée St. Louis where he was to have his lessons. The school stood on the slope of the hill that led down to the Seine, but it did not occur to Louis to fish in *that* river. In the evening he returned to Pension Barbet to do his work and sleep. All joy had gone out of life. There was no glamour now about the École Normale, though it was only round the corner in more senses than one. Kindly M. Barbet tried to interest him, tried to persuade him that he would soon be happy in Paris. All in vain! The boy was making himself ill. He couldn't sleep! He lay awake repeating to himself a line of verse:

“How long is night to watchful grief.”

Oh! Louis Pasteur! There *were* moments when other boys could give you points! His gay friend, Vercel, whose belief in his future was as strong as

ever, tried to comfort him. He was as useless as M. Barbet. Louis only said to him: "If only I could get a whiff of the home tan, I should be all right!"

October had dragged its weary length to an end. Dark November had got rid of its two first weeks. Some one said: "There's a person to see you: they're waiting near-by."

A few steps down the Feuillantines, you come to the rue St. Jacques. At the corner, there are three wine shops now. To one of them Louis was led to discover the mysterious "somebody." In the shadow of the back parlor, a man was sitting, his head buried in his hands. Jean Joseph! His father come to take him back to Arbois!

Did the very cobbles of Paris lament under the coach wheels and all the inquisitive fates prick anxious ears, as the two white horses and three brown galloped Louis Pasteur backwards. . . ? Away from Paris?

Don't despise him. A dog eats grass when he is sick; nobody knows why. And Louis Pasteur was going to have in after years a flair for unexpected cures. Perhaps he knew that he needed his "whiff of tan." At any rate, he had learned that to travel back is as easy as to travel forward. He would be afraid no more.

What next? The traveler, the envied adventurer, who had set forth for Paris in a coach, was back among his school-fellows at Arbois College. What explanation did he give them? How did they comment on the sudden abandonment of such a fine fate? What was going to become of his own hunger for work in the little unambitious place? Louis took out his colored chalks and drew portraits, portraits of everybody who wanted a portrait drawn. They were good portraits, too—worth taking to America and mentioning in print. The fate of all the sad-eyed children the world over, of brave mothers, of patient peasants trembled on the brink. Was the world going to have another artist—great as artists are—when what it really needed was some one to open the door to the hidden secrets of life?

One thing lead on to another when life is in a good temper. Among Louis' portraits was one of the Mayor of Arbois, all decked up fine with silver embroidery and tricolor scarf. Mr. Mayor, no doubt, kept a warm corner in his heart for the clever young artist and did not forget to compliment him, when, at the prize-giving, he went off with more prizes than he could carry. Clearly . . . clearly . . . a boy like that *ought* to try for the École Normale; but from Besançon this time, not Paris. Besançon was near! Wasn't it also the capital of Franche-Comté? Almost home, in fact? Didn't the Cuisance run into the Doubs and the Doubs surround Besançon on three sides? Moreover, Jean Joseph took his skins to the leather market there and

the road through the hills and the Doubs valley was not only lovely, but familiar.

There is not a sunnier, more welcoming town than Besançon, with its glorious river and its high hills, from the highest of which, Vauban's great fort looks protectingly down upon the city. Luck smiled on Louis from the beginning. His master in philosophy was a young, eloquent Normalien with a large portion of the school's special gifts; and those gifts are: love for, and pride in, the school, interest in mind, eagerness for discussion, love of criticism. That his science master was old and disliked Louis' upsetting questions did not so much matter. He could answer them himself.

There was nothing left of the scared, homesick school-boy. He threw himself into work and friendship with fiery enthusiasm. He was suddenly grown up and had a room to himself, where he not only slept, but provided his own meals. He was seventeen by then and he and his chief friend Charles Chappuis, like any other young students, loved talk on every subject. They read poetry and lots of serious books. Fortunately, Chappuis was studying philosophy and Louis science, so that they were not in danger of becoming one-sided. One of Louis' favorite books at that time was *My Prisons*—the reflections of a great Italian when he was shut up year after year, in the terrible Spielberg prison, for no other reason but for having defended the freedom of his country. Perhaps it helped to give Louis a pity for misfortune and a love of independence and freedom which marked his character through life.

After his first examination, he was appointed a supplementary master at a salary of three hundred francs a year—about sixty dollars. What that really was with the change in the value of money, it would be hard to say, but Louis was well pleased with it and thought it would enable him to help his sister to go to a boarding-school. His father, however, was of the opinion that he ought to be sending Louis money to pay for extra lessons for himself.

The next year, Chappuis was to go to Paris and Louis suggested going with him. Rather naturally, his father was unwilling to repeat the experiment. The boys discussed it. "I shall have all my Franche-Comté with me," said Chappuis, "if you come. But your father thinks me your evil genius, persuading you for holidays away from home and now to Paris. Still, it's only because he loves you so much that he prevents you doing what you want."

Louis wanted Paris, because he said the work was sterner. But if his father wanted him to wait a year, he would wait. After all, his whole class had failed to get into the elusive school and two years' mathematics would give him a better chance than one, though they were "dry stuff at best" and

always gave him a headache. He meant to work for both the great schools and take his luck as to whether he was intended for one of the brilliant worldly careers open to the sons of the École Polytechnique, or for some calm professorship reserved for the Normaliens. “Those have their charm,” said Chappuis slyly. Charm or not, it has often been found that you can’t ride two really spirited horses at once and we hear nothing more of the École Polytechnique.

“Chemistry mediocre,” wrote the examiners at Louis’ second examination. We are not told if Louis was worried by the mediocre result, but it has been a merry jest ever since! Louis Pasteur—chemistry . . . mediocre? The boy was declared good enough to be allowed to *try* for the École Normale. He passed fifteenth out of twenty-two. One can’t help wondering what became of the fourteen who beat him; but for himself, the result was not good enough. He would not enter that school fifteenth on the list. Instead, he was going to Paris to try again. Before he went, he did his best portrait—a pastel of his father. His hand was in training and so was his eye; that observant eye that caught everything—an expression, a line, a nothing that other people missed; that accurate, steady hand that did the will of its owner. He went to Paris master of himself.

Pension Barbet was not changed, but Louis was. Aged nineteen, thin faced, clear eyed, slim, not by any means tall, joy and confidence seemed to break through everything he did and said.

He shared a room with two others in the Feuillantines at a short distance from the Pension. To make it more comfortable, he hired a stove for eight francs. The three bought communal wood and Louis a table-cloth for two francs, because the holes and dents in the table prevented his writing.

He had to be up at 5.45 to give a lesson at the Pension from 6 to 7. He and his father had agreed that he should do that in sheer gratitude to M. Barbet. “If one boy whom he has helped,” said Jean Joseph, “shows gratitude, he will feel inclined to help some other poor boy.” So his lesson did not interfere with his work at the Lycée or with what went on in the hall of wizardry he had discovered at the Sorbonne.

It’s a grand place the new Sorbonne—the University of Paris, founded by Robert de Sorbon. But even in Pasteur’s time, the lecture theater held between six and seven hundred people. It was crowded from top to bottom and other crowds were pushing at the doors to get in. If you wanted a place, you had to go half an hour before! Before what? you ask.

“Oh! Only just before the beginning of a lecture on chemistry!”

J. B. Dumas was the lecturer, a man who had words and a voice and knowledge and was able to roll away the clouds of ignorance and show to seven hundred people great new views that excited and delighted them. Pasteur listened spellbound. He wrote home about it and never let go the first thrill of it, nor his love for the man who spoke.

He must already have been finding it hard to distinguish work from play, when a lecture was like the theater and when his holiday Thursdays were spent reading with Chappuis in the library and his holiday Sundays passed in walking and talking philosophy and literature. He went to the real theater four times and to the opera once, like everybody else.

At last, at the end of the school year, he passed fourth into the École Normale. He was so eager to begin that he asked permission to return before the beginning of term—and slept happily in the empty dormitory.

It is also a grand place nowadays, the École Normale. It has the most magnificent science laboratories that the imagination of a chemist could conjure forth—floor upon floor of whiteness and light, acres of glass windows and all the high pressures and low pressures and apparatus the kings of science could desire. Over the door is written that they are built in memory of one, Louis Pasteur, and other famous Normaliens. But in October, 1843, Louis Pasteur was just an excited boy, sleeping in an empty dormitory of what may have seemed to him like a heavenly palace, but looked to others like some dilapidated barracks. It had no laboratory at all and Pasteur had to use a very miserable one at the Sorbonne till he manufactured one for himself out of an attic. France thought her chemists could work in a cellar or a hovel. And, truth to tell, they had not done badly in those places. It is not the laboratory that makes the chemist!



CHAPTER IV

CRYSTAL CLEAR

IT was a Sunday afternoon, Pasteur should have been out for a walk. Instead, he was still in his science apron, absorbed in his experiment; and Chappuis, who should have been walking with him, was patiently sitting on a high stool, not daring to speak, yet pricked in conscience, because he had promised Jean Joseph to prevent Louis from working too much. What could be done with a work-worm? The afternoon was going.

“Oh, well! Let’s walk then,” said Louis at last, a little in the tone of one who means: “The devil take you for a troublesome fellow.”

The Luxembourg Gardens were there quite close, waiting encouragingly for the walkers. There were long avenues of chestnut trees, grassy lawns, lakes, fountains—a lovely place for talk.

Pasteur talked. Chappuis listened or let his mind wander. When people talk about acids with long names and quote whole paragraphs out of learned books at you, you can let your mind wander. But Chappuis suddenly listened. Pasteur was talking about an *indifferent* acid! An acid that didn’t care, that took no notice, was new to Chappuis and amusing if nothing else. Pasteur’s face was lit with excitement. He was telling a tale. It had happened to the windows of the old palace of Luxembourg at which they were looking.

A certain man, called Malus, standing at a window of a house in a road behind them, had seen the setting sun reflected in the windows of the Luxembourg. He had a crystal of Iceland spar in his hand, and, as any one might, he held it to his eye and looked at the glittering windows through it. Then, inadvertently, not thinking of anything, he turned it slowly round in his fingers and saw—saw what mortal man had never seen before! The reflected light changed as he turned, varied in intensity, varied regularly, rhythmically. He had discovered that light, after reflection, has different properties from those it had before reflection. Malus gave the name *polarized* light to light changed by reflection in that particular way. It's an odd word to people who don't know much about light, but Malus used it because he said that the luminous molecules, which make up light, had poles around which their movements happened. From his time, polarized light interested a great many people; and Pasteur, that Sunday afternoon, was interesting Chappuis in it.

But the crystal of Iceland spar was interesting, too. Fancy, if you can, the excitement of a Dane, who had been given a beautiful clear crystal and looking through it, discovered that there were two of everything he looked at! So a crystal had revealed polarized light and a crystal had made a man see double. Pasteur was interested in crystals. But what are crystals? If you left your medicine unshaken for a month, you would probably find at the bottom of the bottle, a lovely forest of hard, spiky, glistening trees. Your medicine would have crystallized.

"Crystals," said Pasteur, "they are my study!" All chemists study crystals, but when Pasteur was studying them, there was a mystery among them—a very deep mystery. And mysteries are of two kinds, those that are luscious, because you *can* find out their secret; and those that are discouraging, because no one can solve them. The mystery of the crystals was of the second kind. Mitscherlich, the great German chemist; Biot, the great Frenchman, had both found it too deep for them. Here it is:

There were two salts of acids. One was common, and to be found in quantity in any old wine-vat; the other was so rare that it had only appeared once. And the strange thing about the two was that they were both exactly the same and yet entirely different! Long chemical names are apt to spoil a tale. Let us leave them out for the moment.

These acids had crystals of the same form; the nature and number of their atoms was the same; the arrangement and distance of atoms from one another was the same. They seemed the same. But, if you dissolved the crystals of one, the solution turned that polarized light, of which you have heard, to the right. If you dissolved the crystals of the other, the solution did

not turn the polarized light at all. It was *indifferent*. Therefore, the two acids were obviously different. “Which is absurd!” Even Chappuis’ philosophy could tell him that. When he heard about the indifferent acid, he almost wished he had taken up chemistry. As to names, the common acid, which turned the polarized light was *tartaric*. The rare, indifferent one, had been given the names *paratartaric* and *racemic*. We will call it racemic, because it is shorter.

Pasteur wanted madly to solve that mystery. It was no use saying to him that the very greatest had given it up. For him, there was a mystery. That was enough! He *must* get to the bottom of it. But where could he find racemic to work on? It had been produced only once! A few chemists had kept small quantities of it—not enough to work with, even if they had been willing to give it up to him. Moreover, he was young and not his own master. He had examinations to do, and, when they were done, the authorities might send him away from the laboratories and acids to teach boys.

He just escaped being sent to a post in a very charming town on the banks of the Rhône, where he might have enjoyed fishing, but not chemistry. It looked like wizard chance that the chemist M. Laurent happened to need a laboratory demonstrator, so that the young man, who might have been a schoolmaster, became a humble lab boy.

There he was, bending over the microscope with Laurent! The chief was showing something to his new assistant—a pure salt, which should have had one kind of crystal and was indulging in three. Those crystals again! Had they chosen Pasteur? Or had he chosen them? He hadn’t asked Laurent to show him the salt. Wizard chance?

If he wished to know anything about crystals, he had to practise using a goniometer or crystal measurer. There are goniometers and goniometers—simple hand-made things constructed with a ruler and protractor; and beautiful, many gadgeted affairs with reflectors and wheels. They all need clever fingers and the bigger the crystal, the easier to measure its angles. So, Pasteur, being a wise beginner, chose the easiest crystals he could find—those of a salt of tartaric acid. Chose? Perhaps he was chosen by them. Little did he suspect how those crystals were going to shoot him straight to his mark, like a big arrow from a tiny bow.

But while he was standing over his goniometer or doing lab duty, there was all the rest of his life going on at the same time. He had written a thesis in order to become a doctor of science and was having it printed at his own expense. He was taking a holiday in Arbois and planning one in Germany to learn German. But, alas, the thesis was too expensive and there was no

money left for the German holiday. There was some, however, to buy presents for his sisters and parents. “You shouldn’t do that,” wrote Jean Joseph, “presents are nice, but we would much rather our son kept his money in his purse, or spent it on a good dinner.”

Then there was exciting history going on in Paris, and Pasteur wasn’t of the kind that remained outside his country’s affairs. In February, 1848, Paris had a revolution and sent away the King. Pasteur joined the citizen army, ready at need to fight for the new republic. One day, crossing the Square before the Panthéon, where the French bury their famous dead, he saw a wooden altar, raised to *La Patrie*—the fatherland. “They are collecting money for *La Patrie*,” said the bystanders. Pasteur hurried to his rooms; took all his savings—one hundred fifty francs (about thirty dollars) and laid them on the altar of *La Patrie*. Jean Joseph was delighted. He, too, had known what it meant to offer all to his country; that time he made no mention of a good dinner.

But what was happening to the crystals that formed easily? Pasteur had made a discovery. He had seen on one side of the tartaric crystals little facets that no one had noticed before. “Ah!” he exclaimed, “I shall find that racemic crystals haven’t got those little facets. That will account for the difference between the two.”

But alas! When he examined racemic, it had the facets also. That was a terrible disappointment. Any one else would have given up the horrid things. Pasteur looked more carefully through his magnifying glass. Surely—though the new facets were there, there *was* a difference? Yes, some of the little facets of racemic bent to the right and some to the left, whereas all the little facets of tartaric bent to the right.

Carefully, one by one, Pasteur took the tiny things and put all the right hand ones together and all the left hand ones together. Then he tried them to see what *they* did with light.

And—! Can you guess? The left-hand ones, in a lump together turned the polarized light to the left; and the right-hand ones turned it to the right. And when they were mixed, the two exactly equally, of course, an equal turn to the right and an equal turn to the left would leave even light where it was before. The mystery of tartaric and racemic was solved; and by a boy.

“I have found it!” he exclaimed. And rushing out into the corridor to tell anybody, everybody, he threw his arms round the first person he met and kissed him and insisted on his going out then and there into the Luxembourg Gardens to hear the whole explanation of the two acids, mysterious no more.

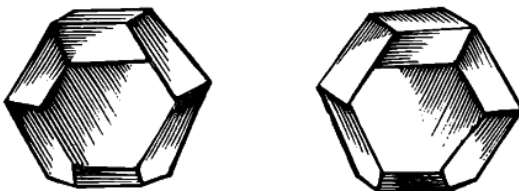
But the moment of his great triumph was spoilt by grief. Pasteur's loved mother died suddenly in Arbois. He couldn't work. All scientific Paris was talking about his discovery. Some couldn't even believe it. Biot especially, the great, old chemist of crystals, wouldn't listen to the news till he had seen with his own eyes. Could a boy have found what he, who had spent a long life seeking, had not found?

When Pasteur took courage again and returned to Paris, he asked Biot to see him. Think of his feelings as he walked up the hill to the Collège de France where Biot lived. He was shy and timid and filled with the deepest respect for a very great man, but he was unshakeably sure of his own discovery.

Biot brought out racemic and made Pasteur prepare his experiment before his eyes. Two days were necessary before the crystals would be formed. On the third day, Biot sent again for Pasteur. There were the crystals. Pasteur took them one by one again, placing the right faceted ones on the right and the left on the left.

"You say," said Biot, "that those left-hand ones will really turn the polarized light to the left and the others to the right?"

"Yes," said Pasteur.



Biot made the solutions himself. He left nothing to chance. When they were ready, he sent again for Pasteur and brought out his own polarizing apparatus. Then he placed the left crystals in the polarizer and saw at once that they turned the light to the left. Nothing more was needed.

"My dear child," the old man exclaimed, without a shade of jealousy, "I have so loved science in my life that this makes my heart rejoice." From that moment, Biot became Pasteur's friend and ally, and his polarizer lives still at the Pasteur Institute, a treasured witness to great events.

But what *was* the fuss about? What did, or does, it matter to you, who are not chemists, what a set of little crystals did with polarized light? Read to the end and *then* say whether it mattered or not—even to people who don't know or care what in the world polarized light may be.

CHAPTER V

A SEARCH

PASTEUR had solved one mystery. But there was another: Why had racemic appeared once and never again? Somewhere, in the world, there must be some more. Pasteur was going to find it.

But he was not his own master. This time, the authorities succeeded in sending him to teach boys in Dijon. It would have been as sensible to put a race-horse to bring up the coal; but Pasteur made no complaint. He went to Dijon and prepared his lessons with care and made chemistry as clear as crystal to the boys, for he was not one to do his work badly just because he didn't like it. And then the Luck, which was looking after the world at that time, found him a post as lecturer in the University of Strasbourg in Alsace.

He had been there fifteen days, exactly fifteen days, when he asked the principal of the University to allow him to marry his daughter. He had, of course, not asked the girl; that is not how things are done in France. He wrote to the principal telling him that Jean Joseph would arrive in Strasbourg in a few days to ask for Marie's hand for his son; and then he set forth very clearly and truly all his own advantages and disadvantages.

"My family is comfortable, but not rich," he wrote. "All we possess is not worth more than ten thousand dollars and I have long ago decided to let my sisters have it all. So that I have no fortune. All I possess is good health, a good heart and my work:

"I left the École Normale two years ago with a degree in Physical Science. I have been a D.Sc. for eighteen months and I have presented a few works to the Academy of Science which have been well received. There has been a very favorable report on one of these works and I have the honor to enclose it with this letter.

"That, Sir, is my present position. As to the future, all I can say is that, unless my tastes change entirely, I shall devote myself to chemical research. My ambition is to get back to Paris, where my chemical work has brought me some repute. M. Biot has bidden me think seriously of the Institute. In ten, or perhaps fifteen years, I might dream of it, if I work hard. But life may do as it will with that dream; it is not that which makes me love science for science's sake.

"I was twenty-six last December."

If any of *you* had a daughter to give away, would you like the man who wrote that letter for a son-in-law? And what of this one which he wrote to

the girl's mother?: "I am afraid of Mademoiselle's first impressions, which cannot be favorable to me. There is nothing in me to please a girl; but my memory tells me that when I have known people for a long time, they have liked me." And this, to Marie herself: "All that I ask, Mademoiselle, is that you will not be hasty in your judgment of me. You might make a mistake. Time will show you that, under a cold and shy outside, there is a heart full of affection for you."

On May 29th, they were married, and Marie, Madame Pasteur, began to share the fun of taking notice of the strange ways of crystals. He promised to lead her to fame; and fortunately he had chosen so well in those fifteen days, that Marie turned out to be the kind of girl who definitely prefers fame to fribble. Pasteur let all his friends into the fun of his chemistry. He sent long reports of everything he did to his father and sisters. When Biot was growing too old to see crystals well, Pasteur made him a set of large cardboard models so that he could follow his discoveries. He wrote to Chappuis: "I am on the verge of mysteries; the veil that hides them is getting thinner and thinner."

One day, Biot, without meaning to do anything out of the common, dropped a note in on Pasteur, who was spending a holiday in Paris. "Bring your crystals to breakfast to-morrow at eight," it said, "Mitscherlich and Rose are coming at nine to see them."

The next morning, it was quite a big breakfast party of many of the greatest scientists, but the thing that caught Pasteur up beyond the clouds was that Mitscherlich happened to mention that he had heard of a manufacturer in Germany who was *again* getting racemic. "He is getting it from a tartar that comes from Trieste," said Mitscherlich.

"I shall go to Trieste!" exclaimed Pasteur. "I shall go to the end of the world. I *must* discover the source of racemic. I must pursue the tartars to their beginning!"

He had no money. Travel was dear. Wouldn't France, the whole country, agree with him that her honor was involved, that the discovery *must* be made by a Frenchman? He was going to write to the President to ask for a traveling grant. Biot dissuaded him. But Mitscherlich gave him a letter to the German manufacturer. Then it was all up with discretion or common sense. Without money, he would go to Leipzig. He went. But alas! That German manufacturer had had racemic twenty years before, or so he said; and what wasn't there was not of much use to Pasteur. Nevertheless, he stayed at Leipzig examining the tartars. Leipzig is a beautiful and interesting city, but Pasteur saw nothing of it except the street between his hotel, where he went when it was dark, and the laboratory, where he went at dawn.

“Tartars,” he said discontentedly, “have all come here from somewhere else. They have all been refined before they arrive. *Where* can I get unpurified tartar? For I believe it is in that that I shall find racemic. I believe it, but it has to be proved. In Trieste and Venice there are two refineries of tartar whose addresses I have.”

So to Trieste and Venice with him! It’s a long way. At Dresden, he had three hours to wait for a passport visa, so he went to look at pictures. Those he liked he marked with a cross in the catalogue. But, as he passed on to the others, he liked them so much more that he had to use two crosses and then three and at last four. He was eager, enthusiastic about everything, knowing his own mind and that quickly.

At Vienna, he found a factory where racemic had been seen only half a year before. It was getting nearer. In another factory, they had never seen any. No, it was the kind of factory that the racemic hunter should have walked straight out from; but Pasteur’s eyes were roving. What was that in the dark corner? A barrel full of tartaric acid crystals and on the top. . . ?

“I think I see the substance. . . !” What excitement! Quick! To the lab with it! A test! It really is it!

The manufacturers had been bothered with a substance which got in their way and spoilt their work. They had not known what it was. It was merely a bother. They had been bothered with racemic that Pasteur had been wanting so long! He had no need to go on to Trieste.

He went, instead, to Prague, because he had heard that a chemist there could make any amount of racemic he wanted out of tartaric acid.

“Oh, yes,” said the chemist airily, “you know that the Pharmaceutical Society of Paris has offered a prize to any one who manufactures racemic? Well, I have done it.”

Pasteur took his hand affectionately and made him repeat what he had said.

“You have made one of the greatest discoveries in chemistry which it is possible to make,” he said, “but permit me to say that in my opinion your discovery is quite impossible. I don’t ask you for your secret. I shall await its publication with the greatest impatience. So it’s really true: you take a kilo of pure tartaric acid and with that you make racemic?”

So thought the chemist of Prague. But what he really did was only what the manufacturers had been doing—separating from impure or crude tartaric, pure tartaric and leaving behind racemic. To make petals out of stamens would be quite a different thing from stripping the petals and leaving only the stamens.

“Great heavens!” exclaimed Pasteur, “what a discovery it would be if he had done what he said. But no. It is impossible. Chemistry is too young still.” But chemistry grew up very fast. On the 1st of June, 1852, Pasteur telegraphed to Biot: “I transform tartaric acid to racemic.” He had done it by treating a kind of tartar with extreme heat for many hours and he had won the world’s prize.

But what did it matter? You who read don’t care any more for racemic acid than for a lot of glassy looking crystals. Wait and see. If you didn’t *know*, you would never believe that out of an acorn, could come an oak, or out of racemic, the money to pay for one war and the surgeon’s skill to cure the wounds of another.

Pasteur began trying tricks with his racemic; to try scientific tricks is a very wise thing to do. He mixed it with some ashes and on the mixture, he scattered seeds of a little mold. Lo! and behold! The mold grew, which was not very surprising, but the racemic was changed. That was rather unexpected.

Then he tried another trick. He put racemic to ferment and the right-turning part of it did ferment, but the left-turning didn’t. It just remained as it was. What was a ferment? In those days nobody knew. People saw beer and wine and sugar fermenting all over the country, but even the greatest chemists didn’t know what a ferment was. Pasteur had seen racemic, which did nothing to polarized light, wake up under fermentation and become active. He said quite boldly: “Suppose every active substance comes from living nature? Isn’t fermentation due to a living being?” It was only a question he was asking. His racemic was making him more and more interested in fermentation.

And just then, fate sent him to a part of the country where fermentation was a great trade.

CHAPTER VI

THE GREAT DISCOVERY

PASTEUR said once that chance favors only the mind that is prepared. Remember that and watch chance in his story. He was appointed Dean of the Faculty of Science in Lille University—a town in the middle of a beet-root growing country, where alcohol was extracted from beet-root by fermentation.

He wanted to interest his students in the country round them, to make them useful to the country. “Has anybody a son,” he asked their parents, “who would not be interested if you gave him a potato and told him ‘from that potato you can make sugar, from sugar you can make alcohol, from alcohol vinegar?’ Who can ask what is the use of a small discovery?” he continued. “A Dane once held in his hand a piece of copper wire joined to the two poles of a Voltaic pile. On the table was a magnetized needle on its pivot. By chance he saw the needle move. From that sprang the electric telegraph.”

The boys of Lille were interested. They flocked to Pasteur’s lectures, two hundred and fifty of them, three hundred. He took them for expeditions to visit factories in the neighboring towns and as far afield as Belgium, and, as they were shown the different processes of manufacture, he asked more questions than his students. The father of one of the students, thinking that here was a college lecturer who took an interest in real things, asked him to see his distillery, where he made alcohol from beet-root, but where things were not going altogether well. Perhaps Pasteur could help? He was kindly and helpful and interested in ferments. Was it quite chance that he was invited?

Pasteur took some fermented juice to his laboratory and put it under a microscope; not a good microscope, only a student’s. He made notes. He wrote down his errors in his small, energetic handwriting, for he was always ready to see a mistake and to correct himself. For months and months he worked, adding that to his ordinary duties.

Then he told the father, M. Bigo, that when the ferments were healthy, they were round. As they grew unhealthy, they grew longer. When they were really sick, they were quite long. That small discovery was enough for M. Bigo to be able to keep his fermentations healthy with the help of the microscope. But at that time it was an uncommon use for a microscope. Did the idea float into Pasteur’s mind that it might be possible to use the

microscope to see health and unhealth in more important things than M. Bigot's ferments?

But what were ferments that Pasteur was now looking at so carefully? You all know what fermented jam is when you refuse to eat it because it looks as if it is full of froth. Yet other people buy fermented grape juice at several dollars a bottle. Evidently there are different kinds of ferments! Before Pasteur began to look at them, people used them without knowing what they were. There was a traditional receipt for making wine, or beer, or vinegar. When the making went right, it was good luck; when it went wrong, it was bad luck, or the weather's fault, or even the hand of God. Fermentation was a mystery. Everybody left it at that, though some people spoke grandly about its being "an influence," that is, "something that flowed." Now Pasteur had shown M. Bigo how to avoid bad luck always. He himself wasn't satisfied. What *are* ferments? was what really interested this asker of perpetual questions.

He examined sour milk. In that, too, there were odd round globules. He took them out and sowed them like seed. Why shouldn't he? Why should he? Oh! only just to try! He didn't sow them in soil, because they had never had anything to do with solids. They had come out of a liquid; so he sowed them in liquid and they grew.

Milk globules, sown in a quite fresh liquid, grew. They budded, they made more globules just like themselves. Was it true that if you gave a ferment something to live on, it would live, grow, and produce children? No one had ever dreamed of such a thing.

Pasteur was excited. All round him at Lille, there was fermentation going on. He was making a great success of the University of Lille. It was the most interesting and prosperous university in the provinces of France. But suddenly there came to him a request to leave Lille and go to the help of his old school, the École Normale, which was rather down at heel and unfortunate. Pasteur did not hesitate. He had a kind of motto which said: "Never dwell on the thing acquired." That meant, for him, "When you have been a success in one thing, don't wait to enjoy the honor of it, go on to something that needs doing."

And what a place was the École Normale, that had once seemed such a fairy palace! Its only laboratory belonged to another chemist. Pasteur had to do what he could with two tiny attics under the roof, where in summer his work was stopped by the heat. In the end, after long waiting, he was given the use of a little lodge opposite the porter's, and, delighted he was with it, too! It is still there under the trees and mightily proud of itself for having belonged to Pasteur. Visitors go into his room with bated breath and look

with charmed eyes at a picture of him at work. But when he was actually there working, he had no room for his drying stove except in a hole under the stairs, and he had to crawl on all fours to get to it.

There's a picture for you: On all fours, this great man, whenever he wanted to catch a glimpse of his world-shaking experiments.

And it was not only his queer kind of laboratories that made his work more difficult than it need have been. He had, of course, to lecture and could not do research all the time as he would have wished. But his lectures were making young men love science and that pleased him. What wasted his time was that he had to do things quite unconnected with science; he had to see that the college was painted, that there was fresh sand for the courtyard and that the doors were repaired and such other housekeeper's duties. And as if that was not enough worry, he had to write letters about careers and comforting letters to students who thought themselves not happy; and always he gave a full account of all he was doing to his home in Arbois. He was a very busy man while the ferments waited.

Pasteur never published his discoveries till he was quite certain. "Always doubt yourself," he said, "till the facts cannot be doubted." Those little ferment globules that produced more globules like so many children, caused him to enter a scientific quarrel which had been going on for hundreds of years, and that, just at the moment, had become very lively. You remember Topsy?:

Topsy nebber was born, nebber had a mudder,
Specs I growed a nigger brat, just like any udder!

Well, Topsy was just mistaken. But the mighty quarrel was about whether anything in the world just "growed." Some people said there were things that did. Others said there weren't. An old recipe for producing mice said: "Take some old rags, a little cheese and a few grains of wheat; shut them up together and they will produce mice." In the year 1860 probably no one believed anything quite so ridiculous as that, but they did believe in what they called "Spontaneous generation," which means growing of itself, without any parents to produce it.

Don't you, reader, believe in spontaneous generation? Have you never said: "A draught gave me a cold"? Just as if a cold, which is millions of cold babies born in your nose, could come from mere moving air! You might as well say the oak-tree was mother of the squirrel.

In Pasteur's time, no one knew anything about the origin of the infinitely little beings we now call *microbes*. Biot, his old friend, begged him not to

waste his time studying what never could be found out. But Pasteur was not to be put off.

“I shall try,” he said.

Just then, a certain man, called Pouchet, and his friends, undertook to prove that infinitely small animals and plants could be made to grow in a liquid absolutely free from atmospheric air, that is, absolutely away from anything which might have brought the parent animal or plant to the liquid.

Every one—not only scientists, began to talk about this bold claim in favor of spontaneous generation.

Pasteur set to work to experiment. With an instrument called an aspirator, or inbreather, he drew air through cotton batting. The cotton batting became black with dust. “Was any of that dust the seed of living things?” asked Pasteur. He worked for a year, making tubes of glass of a shape to suit himself and trying all kinds of experiments. Then he produced this statement for Pouchet to think about:

“There is nothing in air, except the living germs it carries, that can produce life.”

Pouchet contradicted: “There is such a lot of life,” said he, “produced in all the things that rot and ferment, that if what you say is true, the whole air would be foggy with germs.”

Pasteur had to show his proofs. He had invented a flask with a long curved neck. Into it he put a liquid, which easily went bad—yeast water, or blood, or something of that sort. Then he boiled it, to kill any living thing which might be in the liquid. He argued that though air itself could get in, any germs or dust, which might be in the air, would drop into the curve of the neck, and not reach the liquid. It looked as if his argument was right, because he kept that liquid for four years without its going bad. But, if using a similar flask, he leaned it over until the liquid entered the curve, that liquid went bad, because it had collected germs from the curve.



Next question! Are there more germs in the air of some places than in that of others? Though you must not think you are getting asked in this little book all the questions Pasteur asked. To answer that question, Pasteur made another flask—dozens and dozens of flasks for each question. This one had a narrow straight neck. Into it, he put yeast water and boiled it. The steam would force the air out. Then he closed the flask by burning the opening with a lamp. Whenever a flask treated like that was opened, air would rush in, carrying any germs it had. Pasteur tried the air of different places in Paris and found that the liquid in every flask opened out of doors went bad.

Next, he took his flasks for a holiday to Arbois. With twenty of them carefully carried, and with his old friend, Vercel, for companion, he crossed the Cuisance and turned up the road to Dôle. To the left there is a little hill, scarcely worth the name of hill. Up the narrow path, Pasteur went to the top, carefully broke his flasks one by one and closed them with a flame. The vine-dressers on the hillside stopped their work to watch the strange behavior of the odd visitor.

“What is he after?” one asked Jules Vercel.

“What would you?” laughed Vercel. “It amuses him.”

Little did they think that the odd visitor was solving one of the little riddles of life itself.

Out of those twenty flasks, only eight showed any alteration. Clearly the air of Arbois was cleaner than the air of Paris, or shall we say freer from germs?

Over towards Salins there is a real mountain, lofty, beautiful, jagged, three-toothed Mount Poupet. Would the air be even cleaner on top of that? wondered Pasteur. Painfully he toiled to the top with another twenty flasks, opened them, let them take in air and then closed them. Only five out of the twenty went bad. Now for a really high mountain! a balloon would be better, something that could leave earth altogether and float in only air. But failing that, Mont Blanc would have to do.



He took thirty-three flasks to Chamonix with lovely, snowy Mont Blanc towering behind. One morning, guides, Pasteur, and a mule set out to carry the flasks to the untrodden snows of the Mer de Glace. Pasteur took the outside edge of the precipice, so that he could hold the precious flasks steady and keep the mule to the path—not that mules ever slip, but they do jump from rock to rock if they get into a tight place and the flasks were too precious for such antics.

On the glacier, Pasteur took out the first flask, raised it high above his head, so that his own breath should not infect the pure liquid, broke the point with pincers that had been purified in fire. In rushed the air, but, oh, grief! there was no way of closing the flask again, because, in the bright white light of the snow, he could not see what the flame was doing, let alone persuade it to go in the right direction when the wind took it hither and thither. He tried and tried again, but he could not waste all his precious prepared flasks.

Patience, down again the party had to go with the remaining unopened flasks and the spoiled flasks. The open ones had to stay in Pasteur's bedroom in the dusty little wooden inn at Montanvert while the guide went down to Chamonix to get a tinker to manufacture the right kind of lamp, which would make a flame visible and keep it steady. Their liquid all went bad.

The next day the procession climbed the mountain again with the remaining twenty flasks. Pasteur left nothing to chance. Air, and nothing but air should enter those precious flasks. He drew, with a steel point, a line on the glass, then he heated the neck and the fine point of the bulb in the flame.

Then, as he had done before, he held the flask above his head and broke the point with steel nippers, whose points had been purified in flame. As the air rushed into each broken flask, it was immediately closed again with the flame.

Out of twenty flasks, only one showed alteration. Pasteur was able to report to the Academy of Science that, “the dusts suspended in air are the only origin, the first condition and necessity of anything coming to life in a liquid, that is the only condition of any liquid beginning to ferment.” And he added: “What we want is to be able to take these studies far enough to prepare the way for a serious research into the origin of different illnesses.”

Do you see now how the story is going? Crystals, racemic, ferments, odd little things not mattering much; but leading on to understanding mysterious grains of life carried in the air which perhaps cause half the sorrow of the world.

It was odd that every man alive did not get up in excitement and say to Pasteur: “Please go on; find for us what sickness is and cure it.” Not at all! They mocked him instead. “The world into which you take us is too fantastic,” they said. M. Pouchet, whom we heard of before, determined to show that Pasteur was wrong: “Are there only a few germs in the air of the Mer de Glace?” said he. “I’ll go far higher than that and show you that liquid will go bad even on the highest mountains.”

He and a large party set out for the Pyrenees. They had no fear. Up the slippery rocks, beside giddy precipices, over eternal snows, through storms, thunder, they climbed, carrying their flasks. They opened them on the Maladetta Glacier three thousand feet above the Mer de Glace and closed them again, but they all went bad. Pouchet said: “See, all air is the same; liquid goes equally bad anywhere.” Pasteur said: “What a lot of trouble those men took to carry their own germs to the Maladetta!”

Then Pouchet asked the Academy to appoint a commission to decide between the rival experiments. “All right,” said the Academy, “come on such a date.”

“No,” said Pouchet, “it may be too cold and the cold will kill the germs.”

“Have any date,” said Pasteur, “but it is quite easy to keep flasks warm.” But even when the date was fixed to please him, Pouchet quarreled with the Academy and the decisive experiment never took place.

Instead, Pasteur brought his experiments to show the world of ordinary people, because by that time everybody was interested in the wonderful discovery—the discovery of microbes, or infinitely little beings.

Into the great Lecture Hall of the Sorbonne, the crowds came trooping: students, scientists, ministers of state, novelists—like the author of *Three Musketeers*, and George Sand, a princess even, and the general public.

On the platform, Pasteur stood before them, grave yet energetic, his gray-green eyes full of life. By his side were two flasks of famous shape—one with a long curved beak, the other straight.

He told them that there are many subjects about which men may have opinions and disputes; but one small subject he had brought to experiment and certainty. He had answered one definite question: “Can living beings come into the world without having been preceded by beings of the same kind?”

No!

Then and there, as if the great Lecture Hall had been his laboratory, he showed the audience his simple flasks—the bent necked one with liquid unaltered for four years, because no living particle had been able to pass the curve; the straight-necked with its sour liquid. “What is the difference between the two? They are full of the same liquid, they are full of the same air, they are both open. The only difference is this: In this one, the dust of the air and its germs can fall into the flask and reach the liquid and produce microscopic beings. In this other, it is impossible, or very difficult for the germs of the air to reach the liquid.”

Then pointing to the curved flask, he summoned up in noble words the great discovery:

“In all the immensity of creation, I have taken my drop of water and I have taken it full of rich jelly—that is, to use the language of science, full of elements most suited to the development of small beings. And I wait, I observe, I question it, I beg it to be so kind as to begin over again just to please me, the primitive act of creation; it would be so fair a sight! But it is mute! It has been mute for years. Ah! That is because I have kept far from it, and I still keep far from it, the only thing that it has not been given to man to produce. I have kept from it the germs that float in the air; I have kept from it life, for life is a germ and a germ is life. Never will the belief in spontaneous generation arise from the mortal blow that this simple experiment has given it.

“No, there is no circumstance known to-day in which it could be said that microscopic beings have come into the world without parents like themselves.”

The audience welcomed the words with wild applause and well they might, for it was the discovery of a mighty world. Man had begun to look

into the world of his enemy—the world of the infinitely small and infinitely dangerous.

But that discovery, that changes in liquids are due to living bodies, made Pasteur undertake some very interesting and very practical experiments on wine. French wines were very delicious, but they often could not travel. The poor sailors, who took wine on their long voyages, were drinking vinegar before they came home. Foreign customers complained that French wines did not keep, and France lost much trade.

Pasteur rigged up a rough and ready laboratory in an old coffee-house in Arbois and examined wines through his microscope. He found the living bodies which made good wine—the true wine ferments; and he also found other bodies which turned the wine sour, or bitter, or “ropy.” How were those living unwanted bodies to be got rid of?



“Heat the wine,” said Pasteur, “in order to kill the germs.”

He had the Arbois tinker make an iron basket, into which he put bottles of good wine and then he put the bottles and basket into an iron boiler. This he filled with water up to the neck of the bottles and heated the water to 50° or 60° C, that is 122° to 140° F. The wine was not altered by heat and the ferments were all dead. The wine would last indefinitely if no air reached it. It was *Pasteurized*.

To show the world the success of that simple treatment, two barrels of wine were sealed and put on the ship *Jean Bart*. One barrel contained pasteurized wine and the other unheated wine. When, after ten months, the *Jean Bart* returned to port, the pasteurized wine was quite good and the

other only just drinkable. Later on, the *Sibylle* sailed round the world with a cargo of pasteurized wine, which kept good through all that long time and through those varying climates. Everything was proving Pasteur right.



CHAPTER VII

GOLD TREES

DID you ever hear of the gold trees of the Cevennes? The Cevennes are high mountains in the South of France. They are red and yellow and mother-of-pearl and cut into great gorges and strange shapes by rivers of an intense, uncommon green. They are so steep that if the peasants did not build stone walls to keep the earth up on little terraces it would all wash away. A terrific work that—carrying stones up mountains to make walls and then carrying the earth up to make a garden, and all to plant the gold tree!

But it *was* the gold tree and so its owners were rich and happy and didn't mind how much they worked. Although its leaves were green like any other tree, it was called the gold tree, because, being a mulberry, its leaves were used to feed silkworms. And in those days all the silk in the world was made by silkworms. It is an interesting story how silk first came to the West. Two thousand years ago, there was no silk except in China; and it was thought so precious that death was the penalty for any one who took a silkmoth's egg out of China. But a Chinese princess loved keeping silkworms so much that, when she married a foreigner, she risked death to take her eggs with her. So silk came to the West and at the beginning of the nineteenth century it was the greatest wealth of Southern France.

Then, suddenly, sickness came to the silkworms; their necks arched, their claws grew stiff, they looked like tiny cats about to spring and they were covered with brown spots as if they had been peppered. Their owners called the illness *gattine*, from *gattino*, a kitten, or *pébrine*, from the word for pepper. Nobody could understand what was happening. Every imaginable cure had been tried. The worms, poor things, had been dusted with sulphur and charcoal, mustard, or sugar, ashes, soot, or quinine. The trees had been sprayed with wine, rum, and absinthe and fumigated with chlorin and coal-tar.

Yet the worms died, and all the country was stricken with poverty and broken-hearted. The country people cried to their government. But what could a government do? It knew no more than the peasants about the illness, but it did know that France was losing twenty million dollars a year.

Dumas, Pasteur's friend and teacher, had been born in Alais, the center of the silk district. He was touched by the misery of his countrymen. Surely, he thought, Pasteur, who had solved so many mysteries, is the man to solve this one. In his sadness he begged Pasteur, for friendship's sake, to save his people. Pasteur was busy with fascinating work and did not want to leave it, moreover, he said he had never even seen a silkworm and would be quite useless. And everybody, except Dumas, thought it foolish to send a chemist to look after silkworms. We want a vet for that, they said.

But Dumas called and France called, so Pasteur went to Avignon to see a man who would introduce him to a cocoon.

"Could you get me a cocoon?" he asked the Insect Man.

"Nothing easier," replied Fabre. "My landlord is himself a dealer in cocoons and lives next door. If you'll be kind enough to wait a moment I will bring you what you want."

So the Insect Man hastened to his neighbor and returned, his pocket bulging with cocoons.

Then Pasteur, having learnt something of cocoons and silkworms, went off up the mountains among the mulberries to question the nursery owners.

"It's cholera, or plague the worms have," said the men. "There's no understanding it. Sometimes the worms die as soon as they are hatched, sometimes they are quite well and yet their moths die; or if the moths are well, their eggs are bad. There's no rime or reason to it and no cause."

"If nobody's eyes have been able to see anything to help them to solve this puzzle," thought Pasteur, "let's see if the microscope will see anything."

So he pounded up a little worm and mixed it with water and put a drop under the microscope. Yes! there were some little round bodies that did not

seem to belong!

“That’s it,” said Pasteur at once to himself, but not to other people. “Those round bodies are the silkworm disease.” His mind was like that! He was so quick to understand that it seemed as if magic were at work. But at the same time he kept his mind in order and made it prove everything up to the hilt before he said anything to other people.

It is a lengthy piece of work, examining silkworms. They have a very varied life history. The hatching of the eggs is arranged for the moment when the first leaves are green on the trees. As soon as the worms appear, girls collect the leaves, break them into small pieces and place them with the worms on wicker trays in a warm place. It is a queer crawly sight to see such a tray with its thousands of worms, literally thousands of tiniest worms. Every eight days the worms cast their skin, and hungrier they grow and bigger and bigger. When they are well, they grow to fifteen thousand times their own weight in one month and harder and harder the girls work to keep them in food. After thirty-two days, when they are as big as a finger, they grow dreamy as if they are thinking of the great work they have to do, and then the girls stick long sprays of heather into the edges of the trays, making overarching avenues of heather above the trays, which, one over the other, reach to the roofs of lofty barns. Up the heather clamber the worms and weave their cocoons. Then they go to sleep as chrysalids and, if they are allowed, come forth as moths ready to lay eggs and start the story again.

But all that happy munching, climbing, weaving was a thing of the past; sickness was everywhere, and ruin. And it is quite easy to see that whatever Pasteur might find out in one year, he would have to wait a year to test it. If he had made a mistake, it would be another year before he could get on the right track. A slow job.

He had been only a few days studying, when a telegram called him away! Jean Joseph, whom he so dearly loved was very ill. Remember he loved “like a Roqui.” His father had been his lifetime friend. He hastened home, but his father had died before he arrived.

But even greater grief awaited him. Camille, his own darling baby of two, was very ill. Pasteur used to sit with her night after night, though he worked in his laboratory by day. But no nursing or watching could save the baby and she, too, died. How he must have longed to find a way to save parents from the grief he was feeling. And though he did not yet see the way, his work was leading him to it. Only a year after, typhoid killed his daughter Cécille, aged twelve, and he was destined to lose yet another child from that terrible illness.

About that time, in 1865, cholera came to Paris and Pasteur, in the hope of discovering something about it, worked on the blood of cholera patients.

“Doesn’t that need courage?” asked a friend.

“What about one’s duty?” replied Pasteur.

Then came what the rest of us would consider a very delightful event in Pasteur’s life. Napoleon III asked him to spend a week with him at his lovely castle in the great Forest of Compiègne.

It must have been a great sight for Pasteur to see how another world-worker lived.

Up the wide stairway with its gilt balustrade, the little chemist went, through the guard-room and the long gallery with its pictures of the life of Don Quixote. Did he, we wonder, notice the lovely furniture, the tapestried chairs with their flowers of enchanting color and their country scenes all woven in Beauvais and Aubusson? Was it a joy to him to sit and lean on soft, exquisite, pictured needlework, and to watch fine people always in a background of delicious color? Did he think his own two children luckier than the baby prince in his two rooms, the one so green with its panels of strange lilies, the other letting in the enchanted park and the long, rose-colored walk?

In the evening, there was a reception in the immense festival room; men in splendid uniforms, women in bright dresses moved among the red Beauvais chairs, their steps falling light on the huge carpet woven by the greatest weavers in the world—the Gobelins. Every one was there: the Emperor and Empress, ambassadors of Russia and Prussia, Sandeau the novelist, Baudry the painter, Viollet le Duc—whose name was to live not-too-greatly respected all over France, courtiers, and ladies-in-waiting. In all the brilliant company, it was to Pasteur that the Emperor and Empress wished to talk, because they wanted to hear about ferments and the Empress wanted to make Pasteur promise not to desert the worms. Pasteur felt he must send posthaste to Paris for his microscope.

Until it came, he shared the life of those who are called great: drove out in the morning in a carriage and six through the lovely, leafy avenues of the forest; listened to the hounds baying the stag; feasted at eve and afterwards witnessed—with what indifference who can tell?—a torch-light procession in the strange glare of which the Emperor’s hounds showed off their tricks of utter obedience. And the next day, again he drove through the beauty of the forest to picnic in the severe cold rooms of the medieval fortress of Pierrefonds. But Pasteur came back from the picnic to keep an appointment with the Emperor’s butler who had promised to try to find some wine going

bad in the imperial cellars—not an easy task. For hours Pasteur remained alone watching a little mold, which was causing the bitterness of the wine, while the other guests rehearsed a play.

At four o'clock he took his wine samples and his microscope and went to the Emperor's book-lined study. He showed their Majesties the mold and other things in the microscope and answered questions about his work. The Emperor wanted to know why he did not turn his discoveries into money and become rich. "In France," answered Pasteur, "scientists would deem they lowered themselves were they to do so."

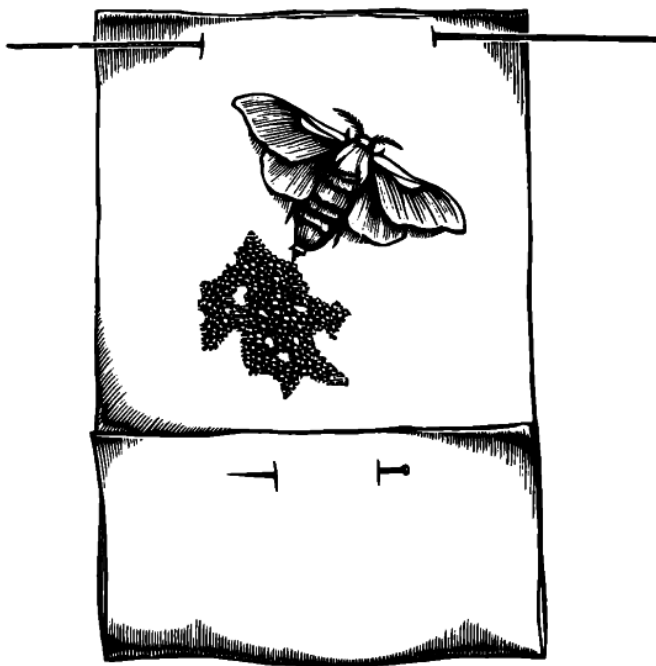
The Empress was so delighted with what she had seen that she insisted on carrying the microscope herself to her tea-room and having Pasteur entertain her guests with a science lesson.

Then Pasteur returned to the silkworms. Just across the river from Alais, along a road which is still only a winding lane, you come to a stream, a little bridge and a villa above it. It is Pont Gisquet amid old trees. There, in as beautiful a spot as one could wish, Pasteur and his family settled with the worms and the microscope in the long, low, white orangery at the side of the house.

Pasteur was now silkworm grower-in-chief. He had a plan of his own. He kept the eggs of each moth separate from all others so that he could know what each moth was doing. As soon as a moth had laid her eggs, he examined her under the microscope. If she had none of those round corpuscles, he became a prophet and said: "There won't be a corpuscle in an egg or a worm and that moth's family will know no sickness." And so it came to pass. The mystery was solved!

But alack and alas! What was this that was happening in a neighbor's brood? He had had eggs from a perfect moth and the eggs themselves were all right with no corpuscles; yet the worms were sick. Pasteur was horrified. Had he after all found out nothing? He went to the neighbor's nursery and examined everything carefully. In the tray above the worms that had come from healthy eggs, there was a tray of worms which had come from any sort of eggs. The worms in the top flat were sick; their dirt was falling on to the food of the healthy worms who were catching the illness!

No wonder! *La gattine* came from the parent moth and was also contagious. Solved? Not yet.



Pasteur had sixteen trays of healthy eggs, all perfectly clean and he should have had sixteen lots of healthy worms. Instead, one lot began to die. With a sad and startled face he picked up about fifteen dead worms each day; and so very dead they were—black, soft and rotting, looking like empty, squashed balloons. Yet, the strongest microscope could not find any corpuscles in them. Was everything a mistake? Had he to start all over again; and was the microscope no use? Nonsense! Pasteur looked more observingly. Under the microscope there were no corpuscles it was true; but what were those straight black marks? call them *vibrios*, for the time being. More experiments were done and Pasteur found that the worms were dying of two diseases, when everybody thought they had only one.

At last Pasteur was able to give silkworm growers a method for securing healthy worms with absolute certainty: Let each moth lay her eggs on a separate square of linen. When she has finished, fasten her in a corner pocket of her square. It is not cruel, because she always dies as soon as she has laid her eggs. Later, pound her body in water and test the mixture under the microscope. If there is a single corpuscle, destroy all the eggs. If there is not one at all, the eggs will be healthy as far as *la gattine* is concerned. To stop the second disease, called *flacherie*, work in the same way, but test only the stomach of the moth for *vibrios*.

You would think the battle had now been won. Not at all! Pasteur had not reckoned with the mighty merchants, who collected eggs—or as they called them, *seed*, from all over the world and sold them to the growers. The seed merchants opposed him bitterly, persuading the growers that their seed was quite good and that Pasteur's method was all folly, because ordinary people could not use microscopes. That made Pasteur furious. He had a temper and he hated to see poor, ignorant peasants lose their labor, because dishonest merchants wanted their profits. The merchants of Lyons went even further; they spread lying tales saying that Pasteur's method had failed so badly that the people of Alais had stoned him out of the place.

The worry of seeing so much stupidity and ill-will preventing the return of prosperity to the silk industry made Pasteur ill, very ill. For a time he lost his speech, and his side was paralyzed. He thought he was going to die: "and I have so much still to do," he said. Other people also thought he was dying; and the government, with indescribable meanness, stopped the building of the new laboratory which the Emperor had granted him. Constantly, the sick Pasteur sent his wife or daughter to the window to tell him how far the walls had grown. They fibbed, because they dared not say the work had stopped. But when he began to suspect it, news was sent to the Emperor, who ordered the workmen back. That illness was not as unlucky as it seemed. When he recovered, he was lame and his fingers were doubled into the palm of his hand; so that when in a few years he wished to join up and fight for France, no one would have him for war, and the world kept him for science.

Long before he was well, Pasteur insisted on getting back to his silkworms. He had to be carried to the train and was so weak that he fell when he tried to walk; but nothing stopped his unconquerable energy, except his little daughter who knew that every one was trying to make him rest, and meant to do her part. "She," he complains, like an adoring father, "pitilessly takes away my books, pens, papers, pencils, with a perseverance which causes me joy and despair."

In spite of the seed merchants, every one was writing to Pasteur for seed. Among the applicants were some scientists from the silk stronghold, Lyons. Pasteur sent them more than they asked: seed and a prophecy. "Here are four packets of seed," he said, "the first will succeed, the second will all die of *la gattine*, the third will all die of *flacherie* and of the fourth some will die of one disease and others of the other."

As Pasteur prophesied, so exactly it came to pass.

There was an old officer of the Emperor's household who kept silkworms in his study at the Tuileries on Pasteur's method. He persuaded the Emperor to lend Pasteur a lovely Italian villa in Illyria, where, in the

clear air of the sunny Adriatic land he might grow strong. Villa Vicentina had once been a silk nursery: the mulberries were all standing; but it was ten years since any profit had been made on the estate.

Pasteur gave twenty-five lots of seed to the peasants and himself kept twenty-five. The steward, hearing that silk raising was going to start again, began selling old, bad seed to the peasants. It would have done your heart good to hear Pasteur's wrath! In one year there was a profit of twenty-two thousand francs at the Villa, and the Italian silk industry adopted Pasteur's method.

So the mulberries were again trees of gold; and the wealth that came to France from Pasteur's researches was so immense it could have paid the indemnity of five milliards that Germany claimed from France after the war of 1870.

But something far more important than wealth had come from Pasteur's work with worms. Have you noticed the wonderful fact that he had shown that living microbes can be the cause of illness in a living creature and that no one had ever dreamed of such a thing before? He had solved, for the first time also, one of the puzzles about heredity and contagion. And best of all, he had found a rule for ridding the world of an infectious disease. True, it was only worms. But what if animals, or human beings were not so different from worms, after all?

Long after these events, Pasteur was sent to represent France at an International Congress on the cultivation of silk in Italy. He was taken to see an immense seed factory; and to his surprise and delight, the name of it, in large letters, over the door was "Pasteur." He exclaimed in a letter to a friend that that homage to his work had made up for all the contradiction and opposition of his enemies. And what a place that seed factory was! The microscopes alone had sixty to seventy women allotted to them, working ten hours a day. Forty thousand moth cells a day were examined. First and second controls made "error impossible." And now, if you go into a silkworm farm, in the remote Cevennes, some wrinkled, apple-faced old woman will say, as she shreds the leaves to her swarming worms: "Seeds are always good now; we never have trouble; it's because of Pasteur."

We cannot leave silk without listening to a few of the things that Pasteur said to the silk congress. In proposing a toast to "Science's peaceful war," he said: "I feel in me two deep convictions: the first is that science has no country, the second, which seems to exclude the first, but yet is only a direct consequence of it, is that science is the highest personification of a country. Science has no country, because knowledge is the heritage of humanity, the flame that lights the world. Science should be the highest personification of

the nation, because among all nations, that one will always be first who leads in the works of thought and of mind.

“Let us fight, then, on the peaceful field of science for the preëminence of our nations. Let us strive, for strife is effort; strife is life, when strife has progress for its aim.”

CHAPTER VIII

WAR

Je croirais mériter la peine des déserteurs, si j'allais chercher loin de ma patrie dans le malheur une position matérielle meilleure que celle qu'elle peut m'offrir.

ON his way home from Illyria, Pasteur had a call to make. In Munich lived one of his chief opponents, the old German chemist, Liebig. Liebig received him with pleasure, asked him to dinner and in the meanwhile, showed him his laboratory. Suddenly, Pasteur saw what he thought were some of his own experiments being done. "Have you," he said, "come to agree with me?"

But Liebig hurried on, talking of other things and quite incapable of hearing anything Pasteur said. He was rather deaf. At the door he showed his guest out, excusing himself on the score of ill-health, for not giving his honored guest a longer interview. He had forgotten all about dinner.

By the time Pasteur reached Paris, the terrible Franco-Prussian war had broken out. His paralyzed arm prevented his enlisting. His home, the École Normale, was turned into a hospital and his friends told him that, in Paris, he would only be a useless mouth.

Sadly he went to Arbois, feeling, as he said, that his mind had been turned out to grass like a useless horse. How was he to work without a laboratory? He tried to enjoy books, but he wanted to work. From time to time his reading was interrupted by the town crier with his trumpet. War was so close, in their own land, around their capital; yet the news was so scant. With beating heart, every one would rush out to the bridge over the Cuisance to listen to the crier. How, as he began his raucous shout, every one listened with hope! With what despair, they must have heard of the French defeats—defeat following defeat, armies routed, cities taken, the Emperor surrendered, eighty-three thousand soldiers starving in snow and mud, waiting to be taken prisoners into Germany, the bombarding of open towns, the last horror of the siege of Paris, the terrible peace, when Alsace and Lorraine were taken away to be ruled by the hated foreigner.

Pasteur's grief flamed into anger. It was not the natural horrors of war that had touched his mind so much as the unnecessarily cruel deeds. In Arbois, a small confectioner's boy, whom his neighbors loved to call Biscuit, ran out to see the show of the Prussians marching in after victory. They shot him just where the tall poplars still guard the entrance to the town. A little farther along the road, where a path runs to Montigny, a shell-

shocked soldier let off a gun by mistake. They shot him—and an old peasant working among his vines, and a boy and his father peacefully eating their mid-day dinner at home.

Pasteur could do little; but true to his own teaching that one must do what one can, he sent back to Germany the doctor's diploma which he had been awarded by the University of Bonn. "The sight of that parchment is odious to me," he wrote; "I feel offended at seeing my name, with the qualification of *Virum clarissimum* that you have given it, placed under a name which is henceforth the object of execration to my country, that of *Rex Gulielmus*."

Pasteur could get no news of his soldier son Jean Baptiste, a boy of eighteen, who should have been demobilized. Unable to bear the suspense, he, his wife and daughter set out, one winter's day, in a shaky old cab to look for the boy.

The wild winds of the Jura were tearing through the mountain gaps with their own peculiar ferocity. The road wound up and up through cuttings in the scree, over the pass to Montrond. There, in a little inn, they camped out almost like gipsies. The next day, they toiled on over the bleak, wind-grieved tableland, past the villages from which Pasteur's ancestors came, through the pine forests whose dark branches were laden with snow, to Censeau, where they slept.

Still higher mounted the unprotected road. It is a way almost unbearable in Spring in a closed car. One shivers to think what it was like in winter in a rattletrap cab. They slept the next night at the little village of Chaffois, and so came on the next day, almost to the Swiss frontier, to Pontarlier.

Pontarlier was full of disbanded soldiers, taking refuge round fires in the street, or huddling in the cold churches. Madame Pasteur went from one to another asking if any one had seen her son. Suddenly a passing soldier overheard her question.

"Sergeant Pasteur! Yes, he's still alive; I slept by him last night at Chaffois. He has stayed behind, he's ill."

So the family and their lost son had all slept in the same village, such a tiny village, and yet they had missed one another.

With excitement, longing and fear in their hearts, they turned to go back the way they had come; but they had hardly gone beyond Pontarlier gate when a muffled soldier sprang from a cart that was passing them. It was the boy!

The young soldier could not stay in France. He had to escape to Switzerland, and Pasteur went with him.

When he returned, he had nowhere to work and work was necessary to him. The École Normale had been bombarded; Arbois was a Prussian depot. Italy offered him a home, a laboratory and the opportunity to work. Pasteur hesitated. In unhappy France, he could do nothing. In Italy, he might serve France by carrying the fame of French discoveries into foreign lands. The Italians were so anxious to get him, that they raised the salary they were offering him. They thought he could be bought for much money. They made a mistake. Pasteur could not bear to think of being comfortable while his country was in distress. He would remain in France and bear her misery with her.

Besides, there was a thing he could do perhaps. French beer was less good than German. He might be able to find out why and make it better, because he suspected that its faults were connected with ferments.

Between Clermont-Ferrand and the fashionable Spa of Royat, there is a busy working district, called Chamalières. In the main street is a prosperous brewery. Go there now and ask anybody, a lorry driver or busy sweeper, if they know anything about Pasteur and you will get an answer full of pleasure and interest: "Of course, Pasteur was there! Pasteur did experiments there. It was there that the idea of *pasteurized* beer began." Then you enter. The owners are glad to show you round because of Pasteur and they will answer very definitely all your questions.

It was very different when Pasteur went there, because even the owners did not know the answers to his questions. They made beer as they had always made it. If it went wrong, they blamed the yeast and threw it away and got more yeast. Nowadays when you come to the huge vat full of foaming yeast, they tell you proudly: "Yeast never goes wrong; we use tested yeast; you will remember that Pasteur gave us a method of testing yeast."

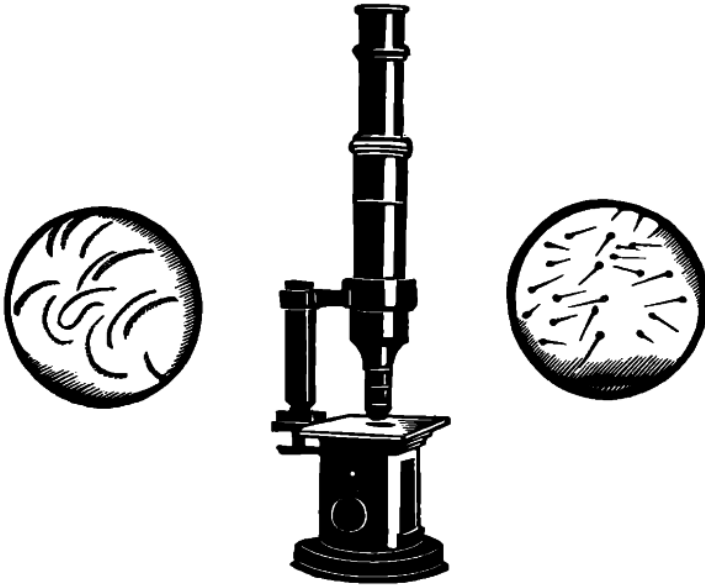
A brewery is a very wet place to visit. You wander along passages that look like streams between great tanks of quiet beer; you climb wet ladders and look down on squares of foaming yellow; shiveringly, you pass into the cooling chamber and gaze with silent surprise at the giant cylinders in which the beer that has been raised to a high temperature to kill the microbes is being rapidly cooled. Pasteur is in everything you see or hear.

In Pasteur's time, the brewery at Chamalières was too small for him to see all he wanted, so he went to London. As early in the morning as he could, he went to one of the biggest breweries. The manager thought the French visitor had come to admire. He was certainly very intelligent and rather odd. He asked questions and begged to be allowed to put some balm from a porter cask under the microscope which he had brought with him.

The manager stood by anxious to get on with the visit, and quite unprepared for Pasteur's remark: "Your clients cannot be very content with this!" he said, making a drawing of a microbe he had seen under the microscope. The manager looked startled; he looked twice! Was this a wizard who had suddenly dropped into a London brewery? It was a dead secret that the clients were discontented and that the firm were standing on their heads trying to remedy the defects of their beer.

They brought Pasteur samples of all the different beer in the place. The visit became longer and longer as he pointed out to them all the wrong ferments in their beer. They were ready to learn, for was there not great profit in what they were hearing? And nothing to pay for it! They sent for the owner. He took Pasteur to see all the bad beer that had been their despair, set aside in a corner. It was bad, very bad, but, look as he would, Pasteur could find no disease in it. What a shock!

Yet he felt that the disease must be there. He had the very bottom of the cask scraped and the scrapings examined, and they were nothing but microbes drowned in their own beer. When he visited the brewery a week later, they had bought a microscope.



CHAPTER IX

A PROPHECY FULFILLED

YOU do not believe in prophecies, do you? Yet some come true. Two hundred years before Pasteur, an Englishman—Boyle, prophesied that “the man who thoroughly understands ferments will be able to explain illness.” Was that going to be one of the prophecies that came true? A man certainly understood ferments. But he was not likely to be able to explain illness. He was no doctor, only a chemist.

For all that, he had wanted to be a doctor and to study illness, because he had grieved over the deaths of his own children and pitied every one who grieved for the death of those who die untimely. But animal doctors and human doctors had both objected to a mere chemist being allowed to interfere even with sick caterpillars. What would they say if that chemist ventured to interfere in the profession that of all others guarded its privileges, the profession of physician or surgeon?

It happened that the Academy of Medicine had not only members, but associates, who sometimes were not doctors. Half the members, with one extra to make a majority, elected Pasteur as an associate. Luck was awake at that voting.

And the next Tuesday, a Tuesday in April, 1873, a little lame chemist walked up the steps of the old hospital of La Charité, entered the queerly decorated lecture theater and took a very humble place, quite unnoticed among the doctors of famous name. Little did they suspect what had come among them. How could they imagine that, at a truthful word from that little man, all their ideas and formulas and prescriptions and long-named ignorances would go toppling over like card houses on a slippery table?

In those days doctors taught that people became ill, because they were ill. They were shocked if any one dared to suggest that measles could only come from measles, or chickenpox from chickenpox. For some odd reason they had declared that all progress in medicine would stop if you believed that illnesses come from their own germ and from nothing else. Illnesses that do come from their own germ are called *specific*, and that word the doctors hated. One would not have minded what their opinion was or how hard they clung to it, if they had been successful. But the poor sick were crying out for better things to happen to them. There was one operation that killed every single person who had it done. “Ah!” said the doctors, “it’s the air of Paris that kills these poor people. Let us have a hospital in the country and you will see that we shall be able to do that operation!” So they had their hospital in the country. Ten women were taken into it and ten coffins were carried out.

They had all lived through the war of 1870. They used to poultice wounds and the poultices killed more than the wounds; they bandaged them with old sheets and the old sheets killed those that the poultices missed. A hospital ward made every one sick with the smell of decay and made every one want to stop his ears from the cries of pain that could not be borne. The man who could stop these wounds from getting worse, they said, would deserve a golden statue.

At that first Tuesday meeting, the arguments on the subjects were very heated. When all the famous doctors had had their say, some one politely turned to Pasteur and asked what he thought. Remember he was a mere associate, a nobody; but that did not prevent his answering with such emphasis that the shorthand writer underlined his words:

“The relation,” he said, “between illness and the presence of a living germ is certain. Beer does not change unless a germ is introduced into it and it is possible to oppose its introduction; without a certain filament, there is no sickness in wine.”

What, one wonders, did great doctors think when they heard human bodies compared to beer and wine? What do *you* think? But the thing that mattered was that there was a whole company present that Tuesday who

were delighted to hear something new. The young medical students began to crowd to Tuesday meetings in case Pasteur was going to say something, something new. Wouldn't you, like them, love to sing a song to something new? Especially there was there a boy of twenty-one, a boy called Roux. He had a thin, bony face, bright eyes, a clear voice and a great love of truth. He was going to make a great deal of difference to Pasteur and to diphtheria.

A new life was beginning for Pasteur, not altogether a pleasant one. There was a certain surgeon, M. Guérin, who at the end of the war had thought that it might be Pasteur's ferments which caused all the trouble with wounds. So he disinfected all his instruments and the wound itself and then filtered the air around the wound through cotton batting. Out of the thirty-four people operated on, nineteen had escaped death! No one would believe such a thing. It was too extraordinary, too wonderful. Guérin took Pasteur to the hospital. Poor Pasteur! He could not bear the sights he saw: even a scalpel opening an abscess made him tremble as if he had been cut himself. He came out sick, but he went back.

And then a thing happened that gave him great delight; he received a letter from an English surgeon telling him that he had used his ideas in surgery and was having great successes. Lister, for it was Lister, one of the greatest of English surgeons, who wrote, had believed Pasteur when he said that wounds go bad because of microbes and he had introduced antiseptic surgery into his hospital in Edinburgh.

One of the saddest things in all this world is when a dear young mother dies when her baby is born. It used to happen very often, but Lister taught doctors how to stop that sadness. One day an old-fashioned doctor was lecturing about that mothers' illness and against the idea that microbes exist. He said, mentioning the illness: "I should like to see any one who could show me that microbe."

Pasteur hurried from his place in the hall up on to the platform, and, taking a chalk, drew upon the blackboard:

"Voici sa figure," he said. "Here is its face!"

"If ever you come to Edinburgh," wrote Lister, "I think it would be a real reward to you to see in our hospital how immensely humankind has profited by your work."

After that, you would have thought that all the doctors would have got together to look into Pasteur's work, but they mocked Lister and they mocked Pasteur. He found their mockery and contradiction hard to bear. He loved truth and was patient in seeking her, but very impatient in defending her. When he spoke, his words came in a flood, vehemently. "I have

contradicted my adversaries, proof in hand,” he said. “They have not dared to contradict one of my proofs. Prove my experiments wrong, instead of doing them over again and doing them carelessly.”



CHAPTER X

UNHAPPY BEASTS

FROM all you know of Pasteur, you wouldn't think that the next time you met him he'd be carrying a basket of chickens through the streets of Paris!

There he is coming out of the solemn École Normale, the dome of the splendid Panthéon looking over his right shoulder, and in his hand a wicker cage containing a lively gray hen, a happy black hen and a dead white hen.

A few minutes later it was the Academy of Medicine and the solemn doctors who were surprised by the hens on the table on the platform. Pasteur liked showing people things they could see with their eyes. Once, when his adversaries had told him that his left-hand crystals were really right-hand crystals; and his right-hand ones, left-hand ones, he had made huge cardboard models of them and taken them to the Academy of Science and shown the idiots that it was only a question of which way round you held the things! He didn't at all mind writing "idiot" in the margin of some of his adversaries' books or a disgusted "Oh! Oh!" and his friend said to him as he went home after the crystal incident, hot and angry: "I am surprised you didn't throw your boxes at their heads!"

He had his own way of throwing hens at their heads.

This is what had been happening to account for the hens. The cattle, the sheep, the horses, the pigs, even unfortunate shepherds, farmers and herdsmen had been dying of anthrax. You don't see the word hen in that list do you?

You don't know what anthrax is either and that doesn't matter at all—you are only in the same case as the farmers and shepherds. A shepherdess would be walking behind her lovely flock of sheep in high Auvergne, when

suddenly one sheep would stop, its head down, its legs trembling and itself shivering all over. It was gasping and blood was flowing from its mouth and nose. It would be dead and its body swollen before the old dame could go to it; and if anybody made a cut in it, the blood that came out would be black, thick, and sticky. Then the whole flock would be dead, too, in no time. "Ah! the beasts," said the owner, "they've been on the 'Witch's Hill' or 'the cursed field'," or else "What's the use of rearing sheep? Wasn't my farm always an anthrax farm?"

And the shepherdess would be careful not to touch the sheep, for if she had the slightest scratch on her hand she would be dead, too.

Farmers had a terrible time. It was always the best farms that suffered worst, the finest beasts that died. Half a million francs was nothing for one small district to lose, and francs were more valuable then than now.

Naturally, doctors and vets and chemists were all trying to find a cure, but first they had to find a cause. By then they were accustomed to suspecting a microbe somewhere, and true enough they found him in the blood of an animal that had died of anthrax. They grew that microbe in soup; and in a short while there was a whole handful of him, like a tangle of wool. They inoculated him into rabbits and the rabbits died of anthrax. Splendid! All was clear!

No, not so clear! A doctor inoculated some anthrax blood into a horse, who died at once; but no one could find any anthrax microbes in him.

Pasteur said, "I think he died of something else." And so it proved.

Other people had got so far in studying anthrax, but it seemed to need Pasteur to clear it up for them. He said he thought that the animal which had died of anthrax and whose blood had been used for the experiment on the horse, had been dead so long that a germ of another illness had appeared in its body, and the experimenters had got hold of that even more deadly germ than anthrax and it was of that terrible fellow that the horse had died.

Then, one day, while the doctors were discussing these things, Pasteur happened to say that hens didn't take anthrax.

"They do!" said his enemy, Doctor Colin.

"Be so very kind," said Pasteur, "in exchange for these bacteria I am giving you, to bring me a hen which has died of anthrax."

"Certainly!" said Colin.

Time passed, but no hen came to Pasteur's laboratory.

But Colin came. "My hen!" said Pasteur, even before he shook hands. "Trust me," said Colin, "you shall have it next week."

Then Pasteur went on holiday, but, when he returned, at the first meeting of the Academy, he greeted Colin with: “And my hen!”

“I have just gone back to my experiments on anthrax,” said Colin. “I will soon bring it.”

Days, weeks passed. The two never saw one another without requests, promises. At last Pasteur told the story at a meeting of the Academy and added to the surprise of every one: “But I will bring M. Colin a hen dead of anthrax.”

“Ah!” said Colin, “I might have brought my hen. I inoculated two with strong anthrax, but they remained quite well and a greedy dog ate them. If they had lived longer they might have died!”

But Pasteur meant what he said and there lay the white hen dead of anthrax. How had he done what he himself said was impossible? A hen’s natural temperature is 107.6° F.—far higher than that of an animal that dies of anthrax. Pasteur had kept the white hen in a cold bath for a long time, and when its temperature was lowered, he had injected anthrax. The hen quickly died. To show that it had not died of the cold bath, he kept the black hen equally long in a bath and she was quite well. The gray hen had had no bath; but had been inoculated with anthrax and was also well. Isn’t that a nice experiment with its controls? Certainly the white hen had died of nothing but anthrax.

But what was really interesting Pasteur at this time was that horse that had been given anthrax and had died of something else. He had, of course, discovered the something else—a long, wriggling, eel-like microbe. He sowed it, as was his custom, in broth or something else that it could find to its taste, and it grew. Microbes that grow on a liquid that has been sterilized, or freed from all living particles, are known as “a pure culture.” Pasteur cultivated those abominable microbes with the tender care of a gardener growing blue poppies. He put one single drop of the eel-like ones into a cut in a leg of mutton and watched the flesh go green, swell with gas, fall to pieces in a mass of disgusting juice. Excuse the description, but suppose one of those microbes got into a cut on your leg!

“If I were a surgeon,” said Pasteur, “I would heat everything I used till all the microbes were dead. I would pass my own hands quickly through the flame.”

But there was something else that Pasteur learned from that eel-like fellow: he could not live in air. No, but when he died—remember, millions of him—at the touch of air, the dead bodies on top protected their brothers underneath from air, so that they might go on doing their horrid work.

“Still,” said Pasteur, “if these terrible microbes are so delicate that they are burnt up by mere air, isn’t there hope that we may learn to conquer them altogether?” That hopeful thought filled him with a perfect fever of work.

There was work to be done coming in on all sides. Some one published a book by a dead chemist in which Pasteur’s ideas on ferments were contradicted. Ferments, said the book, don’t come from outside, they are in grapes.

“I will grow grapes,” thought Pasteur, “that will never ferment or make wine.” So some mysterious glass-houses were packed off by train to Arbois. As the peasants walked up the Besançon road with their grape *hottes* on their backs, they paused to laugh at grapes, which did so well on the open hillside, being shut into new-fangled houses. But when they saw that some of the bunches were wrapped up in thick cotton batting, they shrugged their shoulders and gave up trying to understand such extravagance. Pasteur had sealed the houses so that no dust from the air or soil could reach the grapes and, to make security doubly sure, he had swathed certain bunches in cotton batting.

There never was a ferment in those grapes; and however much you crushed and bottled them and treated them as if you expected them to make wine, they never would. The ferments from outside had never reached them.

Those grapes, wrapped in their cotton batting, had to be taken to Paris, like the hens, to show to the Institute. They had to be taken upright and uncrushed. A special railway carriage was engaged for them on the express and Madame and Mademoiselle Pasteur had to sit up all night to hold them in turn. But you are not to be sorry for Madame and Mademoiselle. They loved doing it. Pasteur was great fun to have for a husband and father, because he shared all his excitements with his family, and they never could be dull.

But now we have to take a journey to the Beauce—to the great wheat-growing plain of France. Some travelers like it and some don’t. In the Spring, look as far as you will, and there is never a hill to see, only the high sky, only the red-brown earth, lit by streaks of the most brilliant green or softened by the blue distance. Away there against the sky, there may be a clump of dark trees, or, almost certainly, the spire of a church rising out of a gray village; and quite certainly, in the foreground, there will be a plough drawn by one white horse and one brown, with perhaps another white one in front.

Pasteur’s disciples, Roux and Chamberland, were working there, for there anthrax was very bad. The soil was very rich, the grass luscious, the

beasts well fed and valuable. It was that kind of beast which always died. You who love horses and cows, and perhaps pigs, must feel sorry for the farmers.

Pasteur used to go to Chartres, the capital of the Beauce. He slept at the hotel de France and very early in the morning drove out along the Paris Road, listening as he went to all that Roux told him of how the work was doing. Quite soon they turned to the left to St. Germain-en-Gattine, a tiny village, just within sight of the famous spires of Chartres. By the village pond is a large and beautiful farm. The farm-house is covered with wistaria and the farm buildings are stately and full of fascinating animals; first the horses and then the cows and then proud rams, fat and tame; and lastly, twelve hundred sheep and lambs in the very folds where Pasteur visited their ancestors.



There is a bust of Pasteur over the door and out from that thatched cottage with its “half-door” comes a little old woman to tell you how she used to cook for Pasteur. She is over ninety and still puts on her wedding dress to have her photograph taken. Then you lean on the gate on which Pasteur leaned, and watch the sheep under the apple trees, as he watched them, till his friend reminded him that it was growing dark and that soon the spires of Chartres would be invisible.

And why did he watch so intently? Did he expect anthrax to break out under his eyes in a healthy sheep? He did, because he had spilt anthrax

germs on the sheep's hay. The sheep's owner had given him permission to use the whole flock for experiments if only he could find a way to save the farmers from their misery. But those sheep went on browsing as if no experimenter had been meddling with their food. But when Pasteur gave them a few thistles or sharp straw as a little variety, it was a very different tale. Then they died.

The slightest scratch in the sheep's mouth allowed anthrax germs to enter the blood and then good-bye, sheep. So, if you were very careful about the hay, you could save your sheep.

One day, at St. Germain, Pasteur noticed that the soil in one place was of different color from the rest. He walked over to look at it and found it covered with the little hillocks of twisted earth that earthworms make. The farmer told him that just there anthrax sheep had been buried. So, thought Pasteur, do the earthworms turn up the buried anthrax and leave it on the surface for sheep and cattle to eat with their grass? He was terribly excited. He collected some of the earthworms, took them to the laboratory and found anthrax germs in their intestines. So that accounted for the "witch's fields" and the "cursed land" and the "anthrax farms." But a more wonderful discovery than all these was waiting round the corner.

CHAPTER XI

A LUCKY MISTAKE

It was the turn of the chickens. They had chicken cholera, poor things. In the gay clucking crowd, among the fluffy babies, one would stagger, stand still and think, fall asleep, and drop dead. Another would be found dead sitting on its nest and it wouldn't be long before ninety were dead out of every hundred.

The microbe had been seen, but he was not easy to cultivate. A man called Toussaint sent Pasteur a rooster's head. Pasteur's presents were often somewhat surprising, but that was the kind of present he liked. The rooster had died of chicken cholera and Toussaint had tried growing the microbe in yeast water, which many microbes liked; but this microbe simply died.

"Give it chicken broth," suggested Pasteur, and sure enough, that was what it liked. How it enjoyed it! It was a sight to see it grow and multiply. A tiny drop of that soup was enough to kill any hen. Pasteur had guessed that microbes had their preferences like anybody else—some like mutton and others chicken. And though that doesn't sound an important guess, it was, though there is no time to hear about it.

Pasteur tried giving chicken cholera to guinea-pigs. They had no objection. They didn't know anything about it, because they kept quite well. But, surprising fact! Chickens and rabbits, who lived with them, caught it and died. Fancy catching an illness from some one who hasn't got it! That's enough to set people talking, isn't it? But something so wonderful was going to happen that they hadn't time even to chatter about that.

In Pasteur's laboratory, every one was very busy: they had microbes to collect and sterilized soup to make into what they called culture medium. Then there were the hens to inoculate and the times to be kept to see how quickly they fell ill, and there were all kinds of possible cures to be tried.

Every one was very careful and orderly and scientific, and only used the best newly made cultures.

But one day somebody took up some culture that had been put away and forgotten, and with that they inoculated some hens. The hens grew sick, which they were expected to do. But! What . . . in . . . the . . . world! ! ! What next? They recovered! They were not expected to do that. Hens did not recover from chicken cholera.

But there was an explanation. The culture was old and bad and therefore useless. It had lost its strength. So, give them some good culture, perfectly

fresh and vicious stuff!

They had it, but that time they did not even get ill. They just remained well. You could not, however hard you tried, give those hens chicken cholera.

Luck had been about again. A mistake had been made in Pasteur's laboratory, where attention would be sure to be paid to it. Some mistakes are quite useless because nobody pays attention to them, but this mistake had Pasteur to watch it. "What?" he asked himself, "has happened to that old culture?" He decided that oxygen in the air had lessened its power to kill. Perhaps each day that a culture stands, it has less power to kill; till at last comes the day when it has no power at all?

That old culture was injected into hen after hen. None died. Yet, strange, strange fact, hens injected with that old culture could never have chicken cholera. Of course, you, who know all about vaccination against smallpox say: "There's nothing funny about it, it is just the same as vaccination." But it isn't; it is only similar.

In those days, although they used vaccination, they did not know how it worked. No one dreamed of how to get a vaccine for any illness that was not smallpox.

It is scarcely possible to realize Pasteur's excitement and delight at this new vaccine. Was it going to lead to finding other vaccines to protect men and beasts against epidemics, against great sorrows? Would the Russian plague yield to a vaccine? That plague, which in 1879 killed a quarter of the people in a Russian village in a few days?

As if in answer to the question, came news of an anthrax vaccine; but, alas! Toussaint, who thought he had discovered it, had been able only to numb the microbes with heat. Some of his vaccinated animals were able to resist the illness, but others died. Pasteur wanted a vaccine that would save all.

The next happening was very strange. Pasteur found that if he gave a weak anthrax culture to a three-day-old guinea-pig, the queer little animal remained quite well, but if he gave the same culture to a new-born guinea-pig, it died. And, which is the important point, if he made his next culture from that dead baby guinea-pig, the new culture was much stronger and could kill a three-day-old guinea-pig, and so on and so on. He could weaken or strengthen anthrax microbes at will. He could give a slight illness or a bad illness to an animal as he chose. He was indeed a powerful wizard.

Then the world talked! His enemies said: "He must be made to prove this to the world; he must give a demonstration before everybody, so that he

may fail before the world.” And they decided to raise a collection for an expensive experiment. Pasteur’s friends were equally excited, for they wished him to succeed before the world.

A town near Paris, Melun, gave sixty sheep for the experiment which was to be done at the farm of Pouilly-le-fort.

Pasteur vaccinated twenty-five sheep at first with a weak culture, and after a fortnight with a stronger. Twenty-five were left unvaccinated. There were ten over. Pasteur proposed on a given day to inject the fifty with real strong anthrax, and he prophesied that all the twenty-five unvaccinated sheep would die and all the twenty-five vaccinated would live.

On the day fixed for the injection, all the scientists crowded to Pouilly. Colin, Pasteur’s old enemy, told the vet that he shouldn’t trust Pasteur. “The man’s tricky,” he said. “He will give the top of the bottle to the vaccinated and the bottom to the unvaccinated and everybody knows that all the microbes will be at the bottom.”

“I will shake the bottle myself,” said the vet. And he did. Moreover, he gave a stronger dose to all the sheep than Pasteur had prescribed. And each vaccinated sheep with a punched ear had its dose alternately with an unvaccinated sheep whose ear was not punched.

How carefully those sheep were watched in the intervening days. Each day their temperature was taken. Pasteur, as he heard of the rise in temperature of this or that vaccinated lamb, felt his own pulse beat faster. Sometimes he wished heartily that he had not been so dead sure. If he had left just room for one to go wrong! If he had inserted just a little “perhaps”! So much depended on this one experiment. Was it to be a failure or a world-shaking discovery? The night before the great day he didn’t sleep at all. He couldn’t open the telegrams which came from his assistant at the farm. Madame Pasteur had to do that, and even she turned all the colors of the rainbow before she opened the envelope. “Yesterday,” she wrote to her daughter, almost as if she were writing of a child “they found a great rise in temperature in one of the vaccinated sheep. This morning it is quite well.”

Then came a telegram: “*Succès épatant*”—stunning success!

At last, at two o’clock, the time arranged for the great show, Pasteur went to the farm. An immense crowd greeted him with cheers. Everybody was there: ministers, scientists, doctors, vets, newspaper men, mere people. They gazed, they counted, they scanned the marked ears, they made sure of the numbers. But there was no mistake: the twenty-five unvaccinated were dead or just dying, the twenty-five vaccinated were well and the ten who had not been touched were well too.

The anthrax vaccine was found and the law that lay behind vaccination in general had been explained. Everywhere there was rejoicing. "It's hosannas all along the line," cried Bouley. Requests for doses of vaccine poured in from farmers in every direction; thousands and thousands were sent out. Millions of animals, in the course of years, were saved from pain and death.

The nation had to honor the man who "had done the thing." They offered him the highest honor France has—the Grand Cordon of the *Légion d'Honneur*. But Pasteur refused to accept it unless the *Red Ribbon* were granted to his helpers, Roux and Chamberland. The delighted nation acceded to his wish and the news reached the three friends while they were hard at work in the laboratory. There, among the rabbits and guinea-pigs, they flung their arms round one another and embraced—as happy as school-boys at their success and the recognition by their country.

But it was not only France that honored Pasteur. He was chosen to represent her at the International Congress in London. With his usual humble simplicity, he was about to take his seat in the body of the hall when a steward came to invite him to go on to the platform to sit among the greatest there. As he approached, applause, clapping, hurrahs broke out.

"Oh!" he said to his son and son-in-law, in some distress, "I should have come earlier, the Prince of Wales must be arriving."

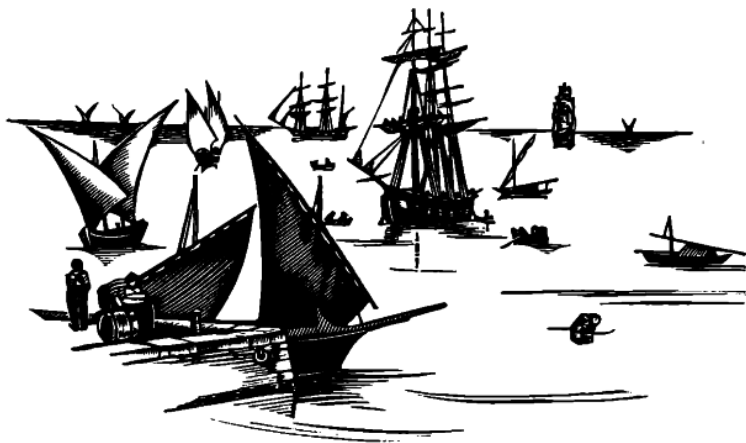
"But it is for you everybody is cheering," said the President, "not for the Prince."

In the President's speech, the only scientist mentioned was Pasteur. As they heard it, the huge audience cheered to the echo and Pasteur had to rise and bow. When at a later meeting he spoke, wildest applause came from all the nations.

He wrote afterwards to his wife that he felt proud at heart—not for himself—"you know my indifference to triumphs! but for my country." The letter went on: "Sir James presented me to the Prince of Wales, to whom I bowed, saying that I was happy to salute a friend of France.

" 'Yes,' he replied, 'A great friend.' "





CHAPTER XII

ACCLAMATIONS

THERE is in France a Society of the very great, called the Academy. Only forty people can belong to it at a time. If one dies, his place has to be filled by the greatest man. Whispers go round, open suggestions are made, there is great excitement to know who it will be. In the old days it used to be the custom for the great man, who was probably to be elected, to go round and visit the electors. Littré the maker of the great dictionary had died, and Pasteur was suggested as his successor.

“He shall not come to call on me,” said Alexandre Dumas, the writer; “I will go to him for condescending to belong to us. It is he who honors the Academy.” Of course, that was not Pasteur’s opinion. One of the charming things about him was that success never made him proud. He remained always boyishly pleased to be thanked and appreciated. He felt that any honor given to him was a proof that the world was glad to honor science.

He had to prepare a reception speech on the life of Littré, but fortunately he was feeling fit for anything, “boiling over” as he said, with energy and new ideas. So a little thing like an important speech, which would have taken all the attention of an ordinary man, did not impede his scientific work. Here is an extract from a letter of Madame Pasteur’s which shows the sort of man she had to look after: “Your father is thinking of going to the Cape in response to an invitation to study goat fever; and he wants to go through Senegal, to collect some healthy germs of pernicious fever. But I try to cool his ardor, as I think hydrophobia enough for him at present.”

Hydrophobia was the most fantastically horrible illness that an animal could give to man, but it was not enough for Pasteur. A ship was reported as coming into Bordeaux, with cases of yellow fever on board, the worst of all fevers. Pasteur dashed off there in the hope of finding the microbe.

“Isn’t it dangerous?” asked some one.

“What matter?” he replied. “Life lived dangerously is real life, great life, a life of sacrifice, a life of example, a life that enables other people’s lives to bear fruit.”

When he arrived in Bordeaux, he took a boat and went out to look for the infected ship in the harbor. “We approached a big transport,” he wrote, “and spoke to the crew from the water. They are all well now, but they had lost seven at St. Louis, two passengers and five of the crew. We went to another big liner and a third. They were all just as well.” One feels that Pasteur was a little disappointed at all that good health. True, the *Condé* was in quarantine, but he was not allowed to go near her; so his hopes had to be confined to the *Richelieu*, which was expected shortly with sick. “I shall await the arrival of this ship with hope,” he wrote. “God pardon the scientist’s passion!”

The *Richelieu* arrived, but her last passenger had died and been buried at sea.

So Pasteur returned to Paris and the event that awaited him there was his reception at the Academy. It was a great day. Just like any one else he took his speech to a friend to have it criticized before the great event. He sat on a stool at Dumas’ feet and read aloud in a low voice. What, one wonders, did Dumas feel in his big armchair, looking down on the greatest man behaving as if he were still the pupil of long ago?

It was another meeting of all the world. Every one who was any one had been clamoring for tickets for weeks beforehand. Pasteur was in ceremonial dress—a green embroidered robe and the ribbon of the *Légion d’Honneur* across his chest. Renan, whose name is known in every country for his *Life of Christ*, was President on that day and had to receive Pasteur with a speech; a witty, humorous speech, it was, made in the loveliest and most rhythmic French: “Truth is a great coquette, Sir,” he said, “she will not be sought too eagerly. When you think you have caught her she escapes you; but gives herself to you if you know how to wait. Nature is a democrat. She likes those who work: she loves hardened hands and only reveals herself to care-worn brows.”

A week later, Pasteur had another fête. Aubenais, a busy little town, perched on a precipitous hill, in the hilly Ardèche, wished to thank him for

all he had done for its country folk. It invited him to join in its festival day when it would unveil a statue to a famous citizen of Aubenas—Olivier de Serres.

The people of Aubenas are particularly gay and friendly. They enjoy a crowd in their narrow climbing streets. They hung the station with flags, made the streets narrower with triumphal arches, brought out all the bands and then drowned the music with their own cheering and vivas!

At the height of the fête, Pasteur was presented with a medal. French medals are really beautiful: the front generally has the portrait of the man who is being honored, but the reverse has often some enchanting picture. On this occasion the reverse showed genii round a cup holding cocoons in their hands and a tiny microscope in the center.

“You,” said the President of the Aubenas silk-weavers, “have been our magician, whose magic has conjured away the dragon which was ruining us.”

“It is Science you honor,” said Pasteur. “And in raising a statue to Olivier de Serres, you are giving an example to France—you are giving an example to all—that they should worship great men and great deeds.” He went on to tell them that he had borrowed a life’s motto from his old friend Biot: *Per vias rectas*—which means that he would always seek his ends by the straight, never by the crooked way. “Those who oppose us pass away,” he said, “the Truth remains.”

If you happen to have read any French history, you will have heard that the South will never take Truth from the North: they want their own. Pasteur, tired as he was, had to go to the South to repeat his experiments for them, so that they might see with their own eyes. First he went to Nîmes, then to Montpellier. He was almost ill, but at sight of the great crowd of eager listeners, not mere sight-seers, but people keen to hear of science and the truth, he forgot his weariness and gave them all they asked of him.

“Find us more cures for our beasts,” they said to him. And he to them: “Days are too short; but I am at your service *usque ad mortem*—to the death.”

Then Aurillac, in the Cantal mountains, invited him to an agricultural show; and well they might, for he had saved them hundreds of thousands of their big, soft-eyed oxen.

It was June, and the high Auvergne, the roof of France, must have added a coolness and beauty to the scene. Pasteur and his family, for he more often than not took them with him, went in and out among the beasts and plowshares and tools, asking questions, observing every detail, learning all

the farmers had to teach. Suddenly, a peasant stopped him, and waving his broad-brimmed hat in the air, shouted: “Long live Pasteur! You have saved my beasts.” As the two shook hands warmly in the steep market place, Pasteur must have felt that he had had no more exciting thanks.

The doctors, too, of Aurillac took the opportunity to drink to “the glory of Pasteur, the precursor of the medicine of the future, the benefactor of humanity.”

Honors came to him and many speeches, but the honor that pleased him most was the speech his old master J. B. Dumas made when he presented to him the medal of the Academy of Science. Pasteur summed up his loves thus: my work, my family, my masters, my country.

He was wanted at an International Congress at Geneva. He set to work to prepare his paper at Arbois with the minutest care. All day he sat at work in his large study at the top of the house. The view was the one he loved, out over the bridge and the waterfall and the far hills of Jura; but he had no time to look at it. He allowed no one to interrupt him till five o’clock, when they dragged him away to take his walk along the Besançon road for his health’s sake. His paper was to be France’s contribution to the Congress; there must be no flaw in it.

At the Congress, no one was interested in any one but Pasteur. We have been hearing already of the things that they discussed, but a little misunderstanding arose there between two great men, which shows how important it is to understand before you lose your temper.

Pasteur had occasion to refer to a collection of Koch’s works. The French word for collection is *recueil*. Koch thought Pasteur said *orgueil*—pride. When, later, Pasteur challenged him to give his opinion on the subject of his paper, the German refused to speak, greatly to Pasteur’s regret, as he was quite unconscious that he had offended. The misunderstanding was never explained during the lifetime of the two scientists.

There was a pause in the acclamations.

It was now the turn of the pigs to claim Pasteur’s help. If you go to Bollène, in the Rhône country, you will see a statue of Pasteur with a pig beautifully sculptured, which looks at you with a gay, triumphant expression, and one ear cheekily cocked. He is telling you quite plainly that Pasteur visited his friends when they were sick and sorry for themselves with swine fever and made it all right for pigs at any rate.

When Pasteur arrived in Bollène, swine fever was very bad. He stood looking over the pig-styes at many sad sights. He could not help

sympathizing with the poor half-ruined farmers, and he lets us see that he sympathized with the pigs too.

Thuiller, his pupil, had found the microbe—an almost invisible thing, in the shape of an eight. He had grown it in veal broth which it liked, and injected it and shown that it was indeed the guilty fellow.

Then Pasteur set to work to make and test the cure. The pigs took to it well and got better. But he was not quite satisfied and wished to go on experimenting in Paris. So he bought ten little pigs, and Thuiller had to travel with them to Paris. Pasteur had them wrapped in straw, because he said that pigs, young and old, felt the cold badly. “These are very young and quite charming,” he wrote, “one can’t help getting fond of them.”

In the next year, 1883, it was the turn of Dôle to welcome Pasteur. This time when he came, everybody knew who had come among them. It rained and it rained but nothing kept the crowd within doors. Everywhere, under the umbrellas, the vivas rang out. The first ceremony was the unveiling of a statue of peace in the square before the church: “Behold Peace, the inspirer of genius and of great work!” the speaker said as the veil fell.

Then a procession walked in the rain to Pasteur’s birthplace to fix a commemorative tablet on the wall. Pasteur had not seen the little house since he could remember. It was such a little workman’s house. The thought of how his father had toiled, and of how little he had received from the world, he, the workman who could scarcely read, the workman who had educated his son so well and allowed that son to educate him in his old age . . . the thought of him brought a lump to Pasteur’s throat. How could he speak there, he who knew how much he owed to his father? He spoke simply and charmingly. Some day you must read the whole speech in its beautiful French.

“Two great things,” he said, “have been the passion of my life and the charm of it: love of science and love of home. Oh! Father and Mother, my dear dead ones, who lived so humbly in this little house, it is to you that I owe everything! Your enthusiasms, my mother, became mine. I have always seen a connection between the grandeur of science and the grandeur of my country. That is because all my deepest feelings were inspired by you. And you, my dear father, whose life was as rough as your rough work, you have shown me what results can spring from long patience in a work that knows no end.”



CHAPTER XIII

MAD DOGS AND OTHERS

THE acclamations were not ended. Edinburgh University was celebrating its three-hundredth birthday. The greatest from every land were invited to join with the Scots in rejoicing over the long life of learning in Scotland. The French Academy of Science chose Pasteur and de Lesseps to represent it. De Lesseps' work was done. He had cut the Suez Canal and made the Mediterranean a corridor instead of a lake, whereby hangs many a tale, mostly sad. But Pasteur still had his work to do and all his tales are joyous.

There was a delightful bit of happiness waiting for him at the London station, for, to everybody's surprise, the train had a private car for Pasteur and his friends. How? Why? It was not that they were rich or had ordered it. By no means, but Younger, the brewer, was so grateful to Pasteur for all the good he had done to brewing without a penny of pay, that he had thought of a graceful way of saying thank you. The French are very sensitive. They like to be liked and Pasteur was delighted with the attention.

Beautiful Edinburgh was in festive mood. Flags and decorations were everywhere and solemnities were crossed with gaieties. There was a sermon in St. Giles's Cathedral and afterwards, a play. Then five thousand gathered in the Synod's Hall to witness the solemn conferring of degrees upon one hundred and thirty-nine distinguished guests. When Pasteur's name was called there was a hush. They all wanted to see! As he appeared, the five thousand rose as one and cheered. What were they cheering? The man who had discovered a new world hidden within our own—the world of the infinitely small things that work havoc: who, by the discovery itself, had made the havoc already less.

That same evening there was a feast. What a brilliant scene it was! The University hall was hung in white and blue; the long tables were spread with finest napery and glass; the thousand guests were eagerly talking, and, one hopes, as eagerly eating, for the program said that they were to listen for four hours to the toasts that should follow.

One would like to have seen Pasteur's expression as he talked to his neighbor, the German, Virchow. It was a surprising tale he was telling him, an unfinished tale, a tale of mad dogs.

"If you had told me those things three years ago," said Virchow, "I should have said impossible!" And yet, three months later, the tale would have been even stranger than it was that night. We shall hear it when the festivities are over.

In Pasteur's speech that night, he found delightful praise for Scotland: "She was one of the first among the nations to understand that intellect leads the world." And of France he said that, "Science and literature are of the true French spirit and the best part of French glory."

The next day, persuaded by the undergraduates to speak to them also, he told them that he loved young people and that the first thing he said to them always was: "Work perseveringly," for work can be a pleasure and alone is profitable to man. But he would have them add two things to hard work—the worship of great men and of scientific method.

After that, he left Edinburgh with two gifts to show him how he had won Scots' hearts; a gift that Mr. Younger gave to Edinburgh University in memory of his visit and a gift of a book for himself, *The Life of Livingstone*, presented by Livingstone's daughter.

Then he went home to his mad dogs! And if you want to understand how really interesting this story is, you ought to be about sixty years old. For then you would remember the time when all the poor dogs wore muzzles in the hot weather and went about with their dry tongues hanging out, longing for water. You might remember, too, your own terror whenever you saw a dog, any dog running towards you, because that dog might have been mad.

Everywhere, even in England, there were mad dogs, and to be bitten meant almost certain death and terrible, terrible pain.

Pasteur himself had a scene in his mind, which he could not forget. He was nine when it happened. A mad wolf had run through the countryside, biting every one in its way and with it had run terror through the hills of Jura. Eight people had died and Pasteur had seen with his own eyes the blacksmith burning the wounds of one man in an attempt to save his life.

Dogs had been mad from the beginning of time. Even Homer talks of them. But for their bite there was no cure. People *talked* of cures: a hair of the dog that bit you; shrimps' eyes eaten whole; a well beaten omelette of bottom oyster shells; sea baths, or, best of all: a pilgrimage to the shrine of St. Hubert. St. Hubert was a hunter of the forest of Ardenne. He had been dead a thousand years, but when the bitten man arrived at his shrine the priest made a small slit in his forehead with a penknife and slipped into it the minutest thread of St. Hubert's thousand year old stole. Then he bound up the new wound and ordered the sufferer not to touch the bandage for nine days.

When all the magic cures failed, surgeons would cut off the bitten limb or bleed the sick man to death, or his friends would suffocate him in bed to save him from the awful agony of a death from hydrophobia.

Right up to Pasteur's time there was no remedy known for the most terrible of illnesses except the burning of the wound and that was seldom done deep enough to save. No one knew anything about the illness except its terror; they did not even know that a mad dog would drink, though the man he had bitten would never touch water to quench his burning thirst. The dog's illness was called rabies, and the man's hydrophobia.

Four years before Pasteur talked on rabies with Virchow, he had been given two mad dogs, the strangest of his gifts. One had bloodshot, miserable eyes, and howled a weird, despairing howl as it snapped at everything within reach. The other was silent with sad eyes and a paralyzed mouth. For four years mad dogs had been constantly about him. Pasteur wanted the saliva of a mad bulldog for an experiment. His assistants held it down with their hands, while he drew its deadly saliva into a glass tube held between his lips.

There have been few braver deeds than that told in any tale of adventure; but there was coming a day when Pasteur would do another deed that needed more courage.

Pasteur and many others were doing all kinds of experiments, but none seemed to give any certain information. They injected, for instance, the saliva of a child who had died of hydrophobia, into a rabbit, and the rabbit died in forty-eight hours; whereas, if it had rabies or hydrophobia, it would have lived a month before getting ill. What disease had it died of? asked Pasteur. Why didn't bitten dogs and bitten people always get ill? He began to think that perhaps the rabies microbe could not always find its way to exactly the right part of the animal where it wanted to live. Where would that be? he asked. The brain, he answered, because the dog goes mad.

So, to make a long story short, Pasteur took to injecting the brain of a mad dog into the brain of a well dog. No one had ever thought of doing that before. And Pasteur was unhappy about it. He could not bear to hurt the dog, and this time he felt that it must be hurt. No one would hurt a dog merely to find out things; but surely it was right to hurt a few dogs in order to save thousands of other dogs from terrible pain? No one, who had ever heard the horrible howling of a mad dog, would think it right that all dogs, forever, should go on suffering from rabies, rather than that a few should suffer a scientist's experiment. But still Pasteur, who had a very soft heart, was worried about the dog who had had to have a hole in its head.

"Seeing is believing," thought his assistant, Dr. Roux, and he brought the dog to see Pasteur. It ran about, sniffed round the room, wagged its tail, said: "At present I am comfortable, thank you." And Pasteur patted it and was grateful to it for being so happy.

That experiment showed Pasteur for certain that rabies lived in the brain; but even with the strongest microscope he could not see the microbe. If he could not see it, how could he grow it as he had grown microbes he had seen? You understand, don't you, that if you can't see a plant, you don't know if that wretched plant has grown since yesterday.

Naturally, many people said: "What can't be seen, isn't there; there is no rabies microbe."

Pasteur had an idea! Suppose he planted the microbe in something alive, not in soup! If he could not see it grow, he might be able to know whether it had grown or not by what it did. So he planted it in a live rabbit's brain. After a long time the rabbit died mad. Then Pasteur took some of its brain and planted that again. The second rabbit died quicker. Hullo! Had the thing grown? It was fiercer anyway. Pasteur took some of that rabbit's brain and planted it in a third; that was fiercer still. He went on till he had something so fierce that a rabbit developed the illness in seven days instead of twenty-eight. At seven days it remained fixed. He could make a rabbit develop rabies on any day he pleased. He could say, as if by magic: "Rabbit A. will take twenty days to be ill, while rabbit B. will take only nine."

He had learned how to make that illness fiercer and fiercer. Could he make it less fierce and less fierce, till it was so gentle it wasn't there at all? He would try. He found that if he used monkeys instead of rabbits, the illness grew less fierce.



He hung a very little of an infected brain in a phial where the air was kept *very* dry. Each day it became drier, and as it dried it became less poisonous till on the fourteenth day it was absolutely harmless.

Pasteur then injected a dog with fourteen-days' old brain. Next day with thirteen-days' old, and so on, till at last, master dog had the fiercest poison of all, the one-day old, from which he ought to have gone mad in seven days. But behold! he was well! And yes! all the mad dogs in the world could lay him in the dust and bite him whenever they liked and he could never go mad.

Pasteur did dozens of experiments. Mad dogs bit inoculated dogs and non-inoculated dogs and always the inoculated dogs lived and the non-inoculated died.

After that, if you loved your dog, you could have him patiently injected and he could never go mad.

But how many dogs were there in France? How many millions? How many vaccinators would there have to be? How long would the dog remain safe or would he have to be done each year? And all the puppies being born all the time? The problem was not solved.

No wonder Pasteur was thoughtful. Poor Madame Pasteur wrote to her daughter that her father was buried in his thoughts, talked little, slept little, got up at dawn and "in a word, continues the life I began with him, this day, thirty-five years ago." Still she loved his thoughts almost as much as he did and longed to find a way to stop rabies.

Pasteur needed a really large kennel. You can imagine he did, and a safe kennel, too, far enough away from people. For though he wanted it for inoculated dogs, who could never go mad, gossips would be sure to say that night and day they heard the mad dogs howl.

There is plenty of country round Paris, with deep forests where kennels, however big, could be easily hidden; but ordinary people were not nearly as keen as Pasteur to get rid of some one else's sickness. They were very interested; they would have loved to hear that a cure had been found, so long as nobody wanted to put mad dogs anywhere near where *they* lived. As soon as Pasteur found a place for his kennel, there was a hullabaloo and the landowners took fright.

But at last, a delicious little palace, no less, and a park were found. No one could have had a prettier domain. Napoleon III and the Empress Eugénie had spent their wedding night there. The Empress loved it and had had all kinds of beautiful trees brought from a tree nursery and planted there. A stream ran by the palace on its way to the Seine and there were meadows and woods and singing birds. The palace itself was falling down and the government wanted to build it up again for Pasteur to live in, but he would

have none of it. He preferred to live in some quiet, simple, poor rooms over the stables where his dogs lived underneath.

You can go there now. The place is altered, for it is one of the great Pasteur Institutes, but you can still see his rooms as they were when he lived there. The floors are of rough boards, the furniture is simple and plain, but the windows look out to the charming park, the stream and the forest. There, in his free moments, his grandchildren used to come to see him, for it was Grandpapa Louis by then. He had measured his wife's height on a door and marked it as a standard, and each year grandson Louis Pasteur Vallery-Radot was measured to see how he grew, and granddaughter Camille, likewise. The marks and dates are still there.

But we mustn't go too fast. The dogs were arriving, lost dogs all, from the dogs' home. Each had his room and his number. All had been vaccinated and were un-mad-able, or *refractory*, as the word is. In the morning, the fifty of them were let loose to play and fight in the enclosure. But for the rest of the time they had to live in their own houses—except one lucky dog, who was rat-catcher, and another honorable dog, who was guard. But they were valiant people, all helping in their odd little way to make the world safe from one great horror, and therefore a happier place. There are many human lives less important and less fine than the life of a dog in the kennels of Villeneuve l'Étang.

The next thing that his dogs showed to Pasteur was that all dogs did not need to be inoculated. It was possible to wait till a dog was bitten and then inoculate him and the inoculation was sure to stop rabies from developing. People began to ask if it were not possible to use Pasteur's vaccine for men. From England came a request to send some over for use. But Pasteur wired "Impossible." Human beings are not dogs or even monkeys and it is not safe to think that what helps an animal will help a man.

Pasteur was, nevertheless, longing to try his vaccine on human beings, but he dared not. He asked the Emperor of Brazil if he would allow a criminal condemned to death to be given the choice of "death or a rabies injection." But the law did not allow any such choice. Then Pasteur thought of trying it on himself, but was dissuaded. When and how would he know if it was possible to save a human being from hydrophobia?



CHAPTER XIV

JOSEPH AND JUPILLE

THEN it happened, the great event! The event for which mankind had been waiting through all the long, long centuries.

Far away in Alsace, French Alsace, that had been made a foreign country for a time, nine-year-old Joseph Meister was going to school. He slipped out of his father's farm a little late and ran to make up for lost time. There he is, in the July morning, a little late school-boy running over the field path on the way to the village of Meissengott, where his school is! His fair hair blowing in the wind, his blue eyes laughing at the world, he was expecting nothing but fun from the day, when suddenly, grocer Vone's big dog, coming from nowhere across the fields, threw him down and bit him everywhere, except on his face, for he kept that covered with his poor small hands which were getting the worst of the bites. At last, for it seemed a long time though it was not, help came. Some one was there with an iron bar to beat off the dog, some one who picked up Joseph and carried him home, while the dog ran off to bite his own master, who shot him. Mad? Yes! There was no doubt the dog was mad, because the vet found pieces of wood and straw in its stomach. So all the tales of mad dogs had come true in Meissengott. It was their turn. The poor parents and Joseph and neighbor Vone went to Doctor Weber in the town of Villé; you can imagine how

frightened they were. Joseph could scarcely walk because of his fourteen wounds, but they urged him on, for they were desperately afraid.

Dr. Weber cleaned the wounds with strong carbolic. “But,” said he, “there is a man in Paris who will help you if any man can. You must go to him.” They could not say no, even if it was a very long journey and they were only timid peasant folk.

So there, you see, he had come at last, the man whom Pasteur and all the world had been waiting for, the man for the experiment that could not be done, which was, even in Pasteur’s words “impossible.” But oh! how sorry Pasteur was for him and for himself. He had thought to try the experiment on some great hulking prisoner or perhaps on an old wise man, but never, never on a little boy.

Pasteur looked at him and looked. They say that if he had been a doctor, he would have known too much and so never dared to try the experiment. But Pasteur had a bold spirit; though he was old and wise, he loved taking risks like the brave young things. His penetrating eyes seemed to go right through Joseph Meister. He would have liked to be able to see whether he was going to have hydrophobia or not. It was two days since he had been bitten and people did not all get ill. Suppose he gave this boy an illness, in trying to save him? Suppose inoculations in boys and dogs turned out to have opposite effects?

Pasteur had to ask other people. He needed time. Would time itself spoil his chance of success? Anyway, he dared do nothing without advice. He arranged a comfortable room for Joseph and his mother and then went to see M. Vulpian and Dr. Grancher.

Vulpian asked *the* question: “Is there *any* way except your way of saving the boy from hydrophobia?”

“No!” said Pasteur.

“Then,” said Vulpian, “it is not only right to try the inoculation, it is your bounden duty.”

That same evening, little Joseph was brought crying to the laboratory. He thought they were going to give him a fifteenth wound, and he didn’t want it. But when it turned out to be only a prick on his right side, he laughed, and went back happily to play with all the white mice and guinea-pigs and rabbits that were around in his lodging.

“They can’t all be working and helping,” he said to Pasteur, “not the littlest ones? I want the littlest ones to be free.” And Pasteur gave them to him.

Every day Joseph went gaily to the laboratory to have his prick. It wasn't he who cared. They might give him as many pricks of that kind as they liked. But why did "dear Monsieur Pasteur" grow solemn and solemn? Joseph hadn't an idea! He didn't know that each day the prick was getting more dangerous, till at last there would be a day when the prick could produce hydrophobia in seven days, unless all the other pricks had made it impossible.

As that important day drew near, Pasteur was almost beside himself with anxiety. He knew, with one side of himself, that he would succeed, but with the other he could not believe it. He loved little Joseph. By that time he was feeling "if only it had been somebody else—not this little boy." He could not sleep, he couldn't work. When he dropped off to sleep he awoke with the nightmare that he had failed, that Joseph was ill.

On July 16th he inoculated the fiercest vaccine. He knew that to be the bravest thing he had ever done. Joseph spent the day merrily playing and then kissed his "dear Monsieur Pasteur" good night and slept like a singing top. But Pasteur did not sleep at all.

After that, Joseph only needed watching to see what happened, but that would have been too much for Pasteur. He went for a holiday to lovely Marrault. When you go there yourself, you will find a lake full of wild fowl and fish, wooded hills, a gem of a church and a long, straggling, gray-stoned village. But if you go on the wrong day you won't be able to get any butter for money, or even for love, which is always more serious; but you will see a stone seat which tells you that Marrault is proud that Pasteur spent three holidays there.

Beyond the seat, in the woods, is the castle where Pasteur stayed with his daughter. Think of him sitting in the calm, wood-enclosed garden, anxiously looking each day for the telegram from Paris which told him how Joseph was getting on. There never was such a waiting! So much depended on those telegrams, and hydrophobia takes so long, so long to develop.

Pasteur was at Arbois, when at last the news came that all the time had gone by and that Joseph was indeed safe.

The great event had happened! Was it not, perhaps the greatest event, save one, that ever did happen? For it was not only Joseph Meister who was cured then. A great door had been opened to science to find escapes for poor men from all kinds of illnesses.

Pasteur was enjoying his holiday in Arbois, but he was very busy. The country people insisted on thinking that he was a wine doctor; and all day long, callers would knock at the door with mysterious parcels. This man's

wine was bitter, that one's musty, another's vinegar had gone slimy. Pasteur took them all in, and eight days later, the countryman knew all about it and could cure his wine.

One day Pasteur went for a drive over the hills to a village called Monay—the most back-of-beyond village you ever saw. But Monay was proud, for it had once owned an artist, a great sculptor, and was setting up a bust to him among its violets. It had not always been proud of the artist, for he had been a bad little boy, who let the cattle and pigs stray, while, with sabots and trousers tied on with string, he hunted the ditches for bits of clay to make little men. No, Monay had never been nice to him in his life, it had begun by calling his little men “idiocies” and it had let him die lonely. But Pasteur had been kind. He used to sit with the sick sculptor and give him his friendship and he was glad to join the village, when, years after, it learned sense and honored its sculptor.

Pasteur had not been made certain about hydrophobia a moment too soon. He had saved a small blue-eyed boy. He had now to save a hero.

When the trees were all turning to gold among the hills of Jura, six little herders were watching their cows in a dip of the valley between Villers-Farley and Mouchard. There came a dog along the lonely road, a dog with foam dropping from his mouth.

“Mad dog! Mad dog!!” they cried, and ran away with the dog after them.

But one did not run. Jupille felt the responsibility of his age and tallness. He was fourteen, and the eldest and biggest. Putting himself between the dog and his fleeing comrades, he stopped it with his long whip. The creature flew at him and seized his left hand. Jupille threw him over and holding him down with his knee, he called to his small brother to give him the whip which he had lost in the struggle. With that he tied the beast's jaws so that he could not bite, carried it to the stream and held its head under till it died.

There was a stir in the town. The Mayor, who knew Pasteur, wrote to him in Paris, telling the story but losing precious time. Pasteur answered that the boy should be sent to him at once, and he sent a message to tell the boy that he must not be afraid of being ill or put to bed; he would feel nothing but a little painless prick. How happy Jupille's parents and friends were when that letter came. They realized that just for three months there had been something in the world which could save the life of their wonderful boy. They must often have said to themselves and to one another: “Suppose this had happened last year!”

In Paris there was great excitement over Jupille. You see he was a hero with a real adventure story attached to him. Pasteur told his tale to the Academy of Science and the Academy of Science passed a vote recommending Jupille to the French Academy for their Montyon prize for bravery.

The deed that Jupille had done was of the kind that awakens the love of beauty in an artist's mind. One artist painted a picture of the Jura scene and gave it to Pasteur. It still hangs in his house. Others made statues of Jupille and the dog from whom illness had taken all the faithful friendly heart of a dog. But in the loveliest statue of all Jupille is holding down his dog and looking up, with happy, grateful eyes, at Pasteur. In that statue he seems to be a picture of mankind—mankind so gallant, so hurt by the madness of the world, yet conquering it and looking with happy eyes into the face of his savior Science.

CHAPTER XV

THE CROWD AND ONE

NOW came the crowds flocking, the crowds of the bitten. In a mere six months, there were going to be one thousand, seven hundred and twenty-six of them. They came from near and far, from France and England, from America and Russia and from all the lands between.

Pasteur needed many helpers. Wasserzug, who spoke six languages and was learning Russian as the seventh, helped the timid foreigners and read all the strange-tongued letters.

Roux and Chamberland stayed apart in the big new laboratory, working for the future, trying to conquer other illnesses with Pasteur's methods.

Viala, who had once been a little, ignorant mountain boy of Alais, whom Pasteur had taken with him to Paris, was the person who did the actual preparing of the vaccine. You would probably like to hear about his work. He lived nearly all his time in a special room at the Pasteur Institute. The room was kept always at a certain heat and on the tables stood the mysterious little flasks, some ready for use, others getting ready. You can see them for yourself in the Pasteur Institute now. Each was of glass, stopped with cotton batting and each had a piece of marrow hanging by a thread from the stopper, while a piece of caustic potash lay in the flask to dry out the poison. Viala, always with Pasteur looking on, took a pair of sterilized scissors and cut the marrow into tiny pieces; then he put each piece into a small glass and arranged the glasses according to the length of time the marrow had been drying. The glass that was to be used for the first injection contained marrow that had dried for fourteen days; the one for the last injection, marrow that had dried for only one day. Then into each glass he dropped one drop of veal soup and, with a sterilized glass rod, mixed the marrow and the soup. The mixture was ready to be injected. You can see how marvelously careful he had to be to put all his glasses in the right place.

It was a happy kind of hospital, because the patients were all well. When they came for their injections, it was almost like a visit to the Zoo, for they used to walk under the chestnut trees and visit the white mice and guinea-pigs, rabbits and hens—and, with special permission, the monkeys.

Every day at 11 o'clock, Pasteur came out to them and called them in. He would talk to them and hear their history. He interested himself in all their needs, where they had found rooms in the strange city, or whether they had enough money to pay their expenses and live comfortably while they were waiting for their injections. He had to number them too and register

them, because numbers were going to be important, comparisons were going to be made. For instance, one writer discovered that, before Pasteur, fifty bitten people died out of every one hundred; but out of those who came to Pasteur, only one died in five hundred.

Among his patients, Pasteur always liked the children best. He kept sweets for them in his drawer and kept all his new, bright half-pence for them. One little girl was clever enough to make a necklace of her bright coins, and no doubt it is in a glass case now, for any family would be proud to tell the tale of how “Grannie” had known Pasteur.

But now comes a sad story: yet in the life of Pasteur one is obliged to tell it, because, if he had been very brave to use his new and perhaps dangerous remedy for Joseph Meister, he was bravest when he used it for Louise Pelletier.

Louise had been bitten on October third. She was not taken to Pasteur till November ninth. Pasteur knew in his heart that it was too late to save her. Should he try? And fail? What would the world say, the world that was looking out with longing for his failures instead of for his successes? Would his failures harm only himself? Or would not his enemies say that his cure was useless, that those who had got well were just those who would have got well without an injection? And so the bitten would cease to come to be cured! Should he try to save Louise, and failing, take hope away from untold others? His work was all in danger; but he decided, as was his nature, to take the risk—to throw away, perhaps, his glorious result in order to help a little unknown girl.

After her injections, Louise kept well so long, that Pasteur hoped that, in spite of everything, she was going to recover. It was December 2nd when she showed signs of illness. Pasteur gave her a second set of injections; all in vain. He sat by the little girl’s bed, because she would not let him go. She loved him so much, he had to stay with her till she died, and afterwards he went away crying. “I would so have loved to save your little girl,” he said to her parents.

It is scarcely to be believed that his enemies rejoiced at that noble failure. They said exactly what Pasteur had expected. They tried to prevent bitten people from going to be treated. They even reported that Pasteur hid his failures. There is no end to what lying tongues will find to say. The wise take no notice, but go their wiser way, and the bitten went to Pasteur.

Four little children were sent all the way from New York, and boats were not quick in those days. The enemies said that, if the people in New York had known the story of Louise, they would not have sent the children. But

the smallest of them, a small boy of five, said when he had the little prick and was sent away: "Did we come all that long way for a little thing like that?" All four remained perfectly well.

Then came a party of Russians, who had been bitten by a mad wolf, which is much worse than a mad dog. They were nineteen poor, silent, bewildered peasants in Paris, for the only French word they knew was Pasteur. Those who were well enough waited in their loose peasant coats, high boots and fur caps among the furry guinea-pigs, but some were already ill and had to go to hospital. It had taken them a long time to reach Paris from Russia.

Pasteur went to see them in hospital; his eyes were full of pity as he walked the wards, because for him they were not merely patients, but each was a loved human being. Of the nineteen, three died, but the sixteen returned to Russia; and great was the rejoicing in that far-away land, for none of their friends had dreamed it possible that any could return. When a mad wolf bit, four out of every five used to die.

Then the world had a thought, and when the world thinks, the fun begins! "We ought to be pleased," thought the world; "something really wonderful is happening. We ought to show how pleased we are and help M. Pasteur to build his Institute and give him a building where his work may be done well."

Everybody began to send gifts. Count Laubespain had begun it. The Czar sent a hundred thousand francs; the Emperor of Brazil joined in; Alsace-Lorraine, Algeria, Italy followed—in fact everybody, rich men and poor men. Even little Joseph Meister's name was on the list. Probably Jupille's was, too; though he may not have read the newspapers, seeing he did not read or write so well as Joseph. Pasteur told him so in a charming letter, in which he begged him to work to educate himself, and he promised to help him. It is rather wonderful that Pasteur, who had so much to do, should have found time to write to those boys.

The most exciting of the generous givers were the actors and actresses. They gave a gala performance to raise money. A gala performance! You know what that is? The theater was crammed; again, everybody who was anybody was in the audience. Even Pasteur was there, who did not often go to the theater. All the great singers or players or actors were on the stage. The most charming passages or scenes were chosen from the greatest plays and songs. There were dances and music and many-voiced choirs, and bright-colored dresses, shining with precious stones. Coquelin, the greatest actor, recited a poem written specially for the occasion, which ended with words like these:

“Under all high heaven, in all the work of God,
(The work that man defames, Oh, strange, Oh, odd!)
There’s nothing near so great; there’s nothing greater than
Those, who by their genius, hold death away from Man.”

And as he ceased, the whole great audience turned to the little silent scientist—the greatest of the great.

Then there swelled out the lovely notes of Gounod’s *Ave Maria*, conducted by none other than the composer. And as the music of the lovely prayer rose and rose, Gounod turned, and with both hands threw a kiss to Pasteur!

“Was it not” asked Pasteur afterwards, “a heart-touching sight to see those great charmers of man, who properly belonged to his moments of happiness, bringing their help to those who served man in his hours of suffering?”

After that, people wanted Pasteur everywhere. His presence brought luck. “Be our President,” said one Society, “and of course make a speech.” “Be godfather to our baby-crèche,” said another, “and talk to us.” “Give the League of Youth its prizes and address them.” He did not say No, and he spoke always interestingly, always nobly, saying always something cleverly suited to his audience.

“Don’t you think,” he wrote to a young author, “that our country has a great need of something which will set youth on new paths and open to it new horizons of honest work, goodness, poetry—tinged with the thought of God and the mystery of our destiny and the greatness of our country?”



Pasteur was tired and ill. A friend offered him a villa by the sea in Italy, but he did not want to go. He wanted to work, and what matter if Paris were cold and gray? But even a scientist's family gets a word in sometimes, and, at long last, a scientist's doctor. So November met Pasteur's train at Avignon with blue sky and sunshine, and the doctors sent a deputation to meet it at Nice, and the blue, white-frothed Mediterranean curled into the little rocky bays right up to the carriage wheels till at last there was the villa with cactus and palms and oranges and roses and camellia buds!

Any one could rest and get well in such a lovely place. Ah! Could they? There was sadness there. A sympathetic man like Pasteur felt sad when he met the Empress Eugénie in exile, a poor old woman, she who had been so great. He met, too, the Prince Napoleon, a do-nothing wanderer on that lovely shore, a nobody, glad to come and talk science with Pasteur. There was also the newsboy bringing newspapers in which Pasteur's discoveries were insulted. Those people said that people died after Pasteur's injections; but they did not support their news with examples. They said only that injections were more dangerous than bites. Pasteur's disciples fought those wild sayings with facts; but he himself was angry and distressed and longed to return to Paris. Then his enemies sent him those horrid things—anonymous letters full of threats. He said: "I did not know I had so many enemies." Their enmity kept him ill. Truly it seemed as if a certain poet was right when he said: "Men do not hate beauty. They love it so much that its mute reproach maddens them, until they seek to kill it, so that nothing should remain in the world to remind them of what they might have been."

But Pasteur little thought what it would be that would free him from his unwanted holiday. At six o'clock one lovely February morning, the earth growled. There was a clattering like an express train going over iron sheets. The houses swayed, staggered, cracked. Pause! Then there were more growls. The flat earth stood up and broke. Houses swayed again and cracked again. While his family was collecting hurriedly to escape, Pasteur was watching the effect of earth quivers on window glass. Not even an earthquake could stop him being a scientist.

No one could stay in a broken house, so the Pasteurs found a carriage and joined the stream of people hastening away. They knew their direction. They were going to Arbois, the best of holiday homes. But the rest, the peasants and the visitors, were just going—they knew not where. Little donkeys were piled high with beds and furniture, scared-faced men dragged them along; little half-naked children clung to their mothers' skirts and the broken houses all along the road watched them pass.

CHAPTER XVI

EVERYWHERE ALIVE

PASTEUR was old by then, a really delightful grandfather, living in his comfortable house at the Institute. His grandson and granddaughter came often to see him and there were always sweets for them in a drawer and something else, too—a lovely little musical box which he took out himself and played to please them. It still lives in the same drawer and it still plays its crystalline far-away tune for very privileged people.

Painters loved to paint him. One made him sad, with his thin, worn face full of pity for people's unhappiness. Another made him majestic. But Edelfelt wondered how in the world he could paint Pasteur, how any brush could show men what they were really looking at when they looked at Pasteur. He followed him round, watching him, and at last, one day he caught his picture: Pasteur in his laboratory puzzling over the secret hidden in a phial.

But though Pasteur sat in his high-backed armchair by the fire, with his two round lamps behind him, and looked on, like other old men, everything around him seemed full of life. He was the life of the great laboratories where his famous disciples were continuing his work. His words were in their ears: "You'll see how all this will grow in the future." Young men loved him. "All of us," they said, "proclaim ourselves disciples of Pasteur."

When the new Sorbonne, a fairy palace of learning, was opened, the students clamored for him, their President, to speak. In their wonderful buildings, science was enthroned in magnificent laboratories that made Pasteur remember the hovels where he and the great chemists of old had worked. The Sorbonne students, in a body, waving flags, went to his house and called for him to come out on to the steps that they might fête him and give him praise—such lovely praise: "In your hands, dear and illustrious master, science knows no art save that of curing men. That is why all civilized nations have joined in building the Pasteur Institute. That is why all the young students of every country salute you."

He was old and ill; yet full of fire still. Long journeys, his friends thought, were bad for him; but when Alais was setting up a statue to his old teacher, Dumas, he would not stay away. "I am alive," he said, "I shall go!" And Alais, in its delight, gave him a present of a silver branch of heather with golden cocoons.

Then came his seventieth birthday. The immense theater of the Sorbonne was crowded in every corner. There were representatives from every great

town of Europe and from all the French towns that had known him.

To the sound of music, Pasteur, leaning on the arm of the President of the French Republic, went on to the platform. Address followed address, for great men were glad to praise him. Lister addressed him in the name of medicine and surgery: “You have raised the veil that for all the centuries made infectious illness a dark mystery.”

His medal had engraved upon it: “To Pasteur, on his seventieth birthday. A grateful France, a grateful Humanity.”

His voice was too weak to have been heard in that great hall, so his speech was read by his son. This is a part of the message he gave: “Young people, trust scientific method, whose first secrets we yet scarcely know. Don’t be discouraged. Live in the serene peace of laboratories and libraries. At the end of your life be able to say: I have done what I could.”

Don’t imagine that his work was finished. A mother wrote to him: “You have done all the good a man can do on this earth. If you wish, you will surely find the cure for the horrible illness called diphtheria. Our children, to whom we teach your name, as that of a great benefactor, will owe it to you that they go on living.” She signed herself: “A Mother.” It was indeed a horrible illness for which she asked Pasteur to find a cure. In one children’s hospital in three years, 2,029 children died of it. But the Pasteurians were already on its track: Germans, French and Japanese were working at it. Dr. Roux and Dr. Yersin, Pasteur’s disciples, had the old stables at Villeneuve l’Étang again filled with horses, for horses were helping them to make the diphtheria cure. Roux made it with serum from horses’ blood and so greedy was the world for it that 50,000 doses were given away by the Institute in three months. Later on, Ramon, Roux’ nephew-in-law, all Pasteurians, you see, discovered the *anatoxin* of diphtheria, which protects children from even catching the illness.

Far away in China, Dr. Yersin discovered the plague microbe, that plague which is known as *the black death* in history. At one of his parties, as a treat, Pasteur was shown that microbe under the microscope. How surprised the people in history would have been, if they could have looked into the future and seen a little old scientist watching the face of their invisible enemy down a brass tube!

In Pasteur’s own laboratory there was his devoted Russian disciple Metchnikoff explaining how all our blood is so made that Pasteur’s discoveries exactly fitted it and its needs. Your body is something like a country that needs protection against the enemy. Its soldiers are in the blood and are called white corpuscles. When an invasion happens, there is a great

arming—mobilization no less, the white corpuscles get ready for the fight and devour the enemy. If they win, they remain armed and no invasion can happen from the same quarter again.

But in a country, if there is an *alarm* of an invasion, there is just the same rearmament as for a real invasion—the soldiers are so ready that perhaps no invasion takes place. Just so with the body. The doctors inject a harmless vaccine; there is an alarm; mobilization takes place; the corpuscles are armed, they remain armed; no invasion is possible.

Under the young horse-chestnut trees at the Institute, Pasteur had a little tent in which he loved to sit and receive visitors. He was ill, but he never complained or talked of his health. He liked talk and it was not often he let a friend go away without reminding him that there is a lot of pleasure in hard work.

In the summer he went to the little wood-encircled palace of Villeneuve, where his plain little room overlooked the ready stream, and where the hundred horses were working so hard to help children against diphtheria. Pasteur spent his time watching them browsing under the trees or, for hours, Madame Pasteur would read the lives of great men aloud to him; or he would hear about the progress of their work from Dr. Roux or Dr. Martin. There he died on September 28, 1895.

But they buried him in the crypt of his Institute in Paris; and on the walls, they painted the chickens and the lambs and the dogs and children he had saved, dancing among the flowers.



No one who died was ever so alive among us as Louis Pasteur. You meet pasteurized milk on any doorstep, and, if you have any imagination, you see his delightful face looking out at you from the mighty pasteurizing plant of

all the dairies of the world, watching over your safety. Every dog you meet wags his tail and smiles at the thought that no one need fear a mad dog any more, because such things have ceased to be. In the sunny mountains, any old silkworm breeder will say to you: "Pasteur saw to it that we never lose our worms." In every chicken run, the hens; in every field, the lazy cows and sheep and pigs say the old bad days are over.

If you travel, a mere inoculation will let you drink strange waters without fear of typhoid. Everywhere the white cleanness of every hospital; every confident doctor, unafraid at wounds or infectious illness; every baby who kicks his chubby legs, alive and gay, is really singing a song of triumph for Louis Pasteur.

TRANSCRIBER NOTES

Misspelled words and printer errors have been corrected. Where multiple spellings occur, majority use has been employed.

Punctuation has been maintained except where obvious printer errors occur.

Some illustrations were moved to facilitate page layout.

[The end of *The Microbe Man--A Life of Pasteur for Young People* by Eleanor Doorly]