# Condensed as excerpts from Antoine Béchamp's book :

## "Microzymas with heterogeny, histogeny, physiology and pathology"

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# Foreword

The book that I have finally decided to publish is the fruit of long research, the starting point of which was the study of a very simple chemical fact.

It had been announced that pure cane sugar, dissolved in distilled water, inverts with time, even when cold; that is to say that this sugar fixes the elements of water to form the 2 glucoses, of unequal rotatory powers and of opposite direction, whose mixture constitutes the inverted sugar.

The chemists knew that the interversion is accomplished under the influence of powerful acids, slowly when cold, almost instantaneously when boiling. It would have been remarkable if such a profound reaction, which determines a splitting of the sugar molecule, could have been accomplished without a provoking cause. I therefore repeated the experiment. The reversal took place, but I noted at the same time that there was mold in the solution; I disregarded it at first, and published the result as a confirmation of the stated fact. However, I had varied the experiment: in one of the solutions I had added zinc chloride, and in another calcium chloride, and the sugar was not switched.

....

Thinking about it, I came to wonder if the mold was not the provoking cause of the reaction. This was a stroke of light. After a few more or less demonstrative tests, I instituted several series of experiments which lasted from 1856 to the end of 1857. The result was conclusive: the reversal occurs only after the development of the mold. And so a research of pure chemistry, in itself very simple, became the starting point of physiological studies which occupied me almost without interruption for nearly thirty years.

The beginning was thus modest. Nothing is more ordinary than to see molds develop in the most diverse solutions, organic or even mineral. If I had stuck to the theories that were received among scientists, I would have neglected mold after having, as a faithful historian, noted its presence. It is for not having considered the fact as a chance encounter, that it resulted in the discovery of the physiological theory of fermentation and, later, **the enunciation of a new doctrine concerning the organization and life**, of which this book contains the history...

I must not conceal it, the fundamental fact on which the new doctrine rests, in spite of the most irrefutable proofs, the verifications which have gone as far as appropriation, is not yet admitted by everyone whose systems and interests it upsets;

The guiding idea, moreover, clashes too much with the accepted opinions not to raise objections. I did not have to neglect anything: it is there especially what obliged me to give so much extent to the work.

*< clarification of priority claims made by Pasteur p.VII à IX>*

...

I have said that this book contains the enunciation of a new doctrine concerning organization and life.

Isn't that pretentious?

That is why it is necessary to explain.

*< history p.IX – X>*

…

It is in this state of science that I began the study of the interversion of cane sugar. I had taken care to ensure the purity of the sugar I was using; I had insisted in particular on the fact that it was devoid of albuminoid matter. I had therefore nothing in my solutions that could be considered as being able, by spontaneous alteration, to give rise to a ferment.

Thus, it is quite certain that in 1854, nothing was known about the function of infusorial molds, nor was their origin known when they appeared in infusions. Mr. Pasteur had, in 1857, reserved the question of the spontaneous origin of his lactic ferment. I had thus, at the same time, demonstrated that they have for origin the germs of the air, that they are ferments, that they secrete a zymase and create the matter of their tissues and their albuminoid matter. But I had also made another observation which was fertile in unexpected consequences. This was the discovery of microzymas and consequently the nature and function of molecular granulations.

## Microzymas or molecular granulations

Under the general denomination of molds, I understood everything that, in these solutions, operated the interversion of sugar and the acidification of these solutions. However, in some experiments, where nevertheless the interversion occurred, I saw only extremely small microscopic forms, without any analogue to what was known among the infusoria. These forms, which the Memoir of 1857 designates by the appellation of small bodies, I considered them as organized, looking at them in the same way as ferments. Little by little I was led to compare them to the molecular granulations that M. Berthelot, in his research on alcoholic fermentation, at the same time, had noted without attributing a role to them, considering them as amorphous matter; then finally to all the molecular granulations of the authors, which were specified as animated by Brownian motion...

In a letter to M. Dumas (September 1865), I even compared molecular granulations to chalk and milk. Finally, in 1866, in a note on the role of chalk in lactic and butyric fermentations, **I name them microzymas.…**

The discovery of microzymas, considered as a new category of organized beings, has been fertile in theoretical and practical consequences of considerable importance. It is this discovery which, when I found that the microzymas of chalk, those of milk, as well as those of the atmosphere can, by evolution, become bacteria, allowed Mr. Estor and me to demonstrate that the molecular granulations of cells, tissues and humours are not amorphous, fatty or other granulations, but really living and organized forms. In short,

from this simple observation it follows that **living organisms, even the highest in the series of beings, contain life in some detached part of this being.**

I have said that in the past it was not possible to see how the problem of organization and life could be tackled experimentally. In fact, the living being was conceived as an indivisible whole whose parts live on the life of the whole.

After death, everything is supposed to be dead in man; in the animal that has just died, everything is dead.

Not two years ago, while discussing these questions with an English doctor, I told him about the persistence of life in the corpse. He smiled significantly! This is the common opinion...

< *development of this common opinion p.XV – XVI*>

… The purpose of these lectures is to demonstrate that the vital, irreducible, physiologically indestructible unit of which the cell itself is formed, is none other than the microzyma. It is the living form, reduced to its simplest expression, having life in itself, without which life does not manifest itself anywhere .... In short, the microzyma is the living unit per se; and this is what cannot be said of the cell.

I did not at first conceive this idea, which flows from the facts as from a clear source; the lectures trace the history of its development. It has been nearly a quarter of a century since it was formulated, and its consequences, even the most remote ones that touch on pathology, have been deduced from it. Mr. Estor, who used to work close to me, became my devoted and convinced collaborator, so much so that in certain parts I do not know how to distinguish between him and myself...

.... I said that there was no lack of verification. In Germany, microzymas were discovered, under other names ....

... A Swiss scientist, Mr. Nencki, professor of medical chemistry in Bern, did not limit himself to the demonstration of the new doctrine, he had the generosity to formulate in favor of the microzymas a claim of priority in good standing:

There is no doubt," says Mr. Nencki, "that the germs of the ferments of putrefaction exist in most tissues of living animals. To my knowledge, it is to A. Béchamp who first considered certain molecular granulations, which he called microzymas, as being organized ferments and who defended his way of seeing with resolution against various attacks. A. Béchamp then formulated the following three propositions based on the research he had undertaken in common with Estor.

1. In all the animal cells examined, there are constant, necessary normal granulations, analogous to what Béchamp called microzyma;
2. In the physiological state, these microzymas maintain the apparent shape of a sphere;
3. Outside the economy, without the intervention of any foreign germ, the microzymas lose their normal shape; they begin by associating in a string, which has been made a separate genus under the name of torula; later, they elongate so as to represent isolated or associated bacteria.

We see," adds Mr. Nencki, "that the later researches of Billroth and Tigel are in their results only the confirmation of these three propositions.

...Mr. Estor and I have never, in speaking of the normal microzymas of organized beings, heard of anything but healthy, living animals, that is, examined immediately after being sacrificed. When there was reason to note other circumstances, we were always careful to do so. Thus, Mr. Estor, guided by the theory, had noted the presence of microzymas in strings and bacteria in the matter of cysts examined as soon as they were opened, thus proving that microzymas could evolve in the living, in the body of man himself, in the pathological state...

...As a result, it was imagined that microzymas are foreign living beings in the organism. Hence the error of those who, when they finally see microzymas in tissues that have become diseased, invariably take them to be parasites of which genera and species have been made...

... I have devoted a whole conference – the 11th – to correct these errors. **The microzyma is not a stranger in the living organism; on the contrary, it is in it that the life and activity of each living center in this organism is concentrated, each one according to the goal it has to reach.**

< *explanation of the recurrent problems with Pasteur …* *p.XIX à XXII*>

...Before Mr. Pasteur, I looked in the air for the cause of the appearance of molds and microzymas in my solutions. Later I demonstrated, what Mr. Pasteur had not done, that microzymas constitute the essential part of what are called air germs, thus giving a body to these germs which were neither spores, nor eggs; while Mr. Pasteur was still looking for the eggs of bacteria, I proved that they were the result of the evolution of microzymas. Long before 1876, ..., I had even investigated whether atmospheric microzymas, far from having been created on purpose, might not be the living remains of extinct organisms: the 11th conference contains the history of this research.

< following ... the discoveries he made, claimed by Pasteur p.XXII à XXIX>

I do not dispute the remarkable nature of the experiments of M. Toussaint and M. Pasteur, concerning the attenuation of viruses; they are very interesting when considered in the theory of microzyma, as I explain in the 14th lecture; but they do not include the system of M. Pasteur. In fact, apart from the truly parasitic diseases, there are no germs of real diseases in the air: smallpox, syphilis, typhoid fever, anthrax, etc. Their existence has never been demonstrated. In the air, there are microzymas; Mr. Pasteur denies it, and I demonstrate that they are those of extinct organisms; that they can be accidentally morbid, but losing their morbidity as a result of a change that I observe experimentally.

I have been a long time trying to understand the reason for the persistence of Mr. Pasteur's attacks. I believe that the situation has been clarified. If microzymas exist and if the theory that follows from their discovery is true, the opposite system is false. And if, from beginning to end, this book has taken on the character of a polemic against M. Pasteur, whose merit I nevertheless like to proclaim, there is not only the incident in London; there is his word, which acquires so much authority from the eminent position he so rightly occupies. I could not help but remark that, having taken as the basis of his latest work on the etiology of disease an untested hypothesis and principles which observation has never confirmed, **he was taking medicine down the wrong road.**

< *continuation idem* *p.XXIX à XXXIV*>

… And now I finish by expressing to the Academy of Sciences and to the Academy of Medicine, my feelings of deep gratitude. The first of these illustrious companies has always admitted our communications and our complaints in the minutes of their sessions; the second has been kind enough to listen to my communications with the benevolence that it never refuses to those who cultivate science with disinterestedness**!**

A. Béchamp

Lille, March 12, 1883

# Appendice

Since 1860, at the Faculty of Medicine of Montpellier, every year, at the beginning of the course of medical chemistry, the preparator wrote on the board the statement of the fundamental principles of my teaching. I reproduce here this table, in order to prove that from that time on, my ideas were fixed.

- There is only one chemistry.
- Matter is endowed only with chemical and physical activity.
- There is no organic matter by essence: all matter is mineral.
- What is called organic matter is only mineral matter of which carbon is necessarily a constituent part.
- Organic matter, chemically defined, is profoundly distinct from organized matter.
- The chemist can, by synthesis, form organic matter; he is powerless to organize it: he cannot create a cell.
- The faculty of organizing matter resides primarily in pre-existing living organisms.
- In organized beings, the various apparatuses of the organism are the place where the mutations of organic matter, organized or not, are accomplished; and these mutations take place according to the ordinary laws of chemistry.
- The plants are, from the chemical point of view, essentially apparatuses of synthesis, the animals apparatuses of analysis.

# 1st conference

## Introduction

**...**The question that we are going to treat, the history of what is fundamental in the living organization, is that of microzymas; and, as you have understood, it is nothing less than the renewal of the bases of physiology, histogeny and pathology. Nothing could be truer; the study of microzymas touches on 2 great problems, the solution of which is equally important to the physiologist and the physician: on the one hand, the origin and the histological constitution of living beings; on the other hand, the search for the cause of the chemical, physiological or morbid activity which manifests itself in them during life and that of their total destruction after death. These phenomena, as we shall see, can only be rationally explained by the experimentally observed properties of microzymas, living atoms that are found at the origin of living beings and after their total destruction.

The ancient systems deliver the generation of living beings to the chance of cosmic forces; ….

## Spontaneous generation

If someone were to tell you today that ... a mouse, a frog, a fly or some other insect was born suddenly, without parents, from damp earth, warmed by the sun, from a pile of rags, ..., from a piece of rotting flesh, we would laugh at the strange observer. However, at the moment I am speaking, there are certainly very authorized scientists who affirm, not these things in these terms, but that certain inferior organisms, moneras and infusoria, can be born without antecedents, and that by evolution, if not today, at least in ancient times, these moneras have successively produced everything that lives in this globe. It is this mode of generation without ancestors that we call spontaneous or equivocal generation, spontaneity, heterogeny.

…< History and description of the experiences of the " spontéparistes " and contradictors p.3 à 25 of which the typical example: Schroeder and Dusch experiment p.19-20 >…

## Pasteur's experience and method

… < the goal is to prove that in the absence of airborne germs, no organism can be born >

Mr. Pasteur built very complicated devices but also very simple ones. What results did he achieve? Whenever he used filtered, clear infusions, in which the microscope did not reveal any particle of the material that had been used to prepare them, he did not see anything organized appear, neither infusoria, animalcule or others, nor molds. In this respect he only confirmed the experiments of Schwann, Helmholtz, Schroeder and Dusch. He failed, in particular, when he operated on milk whenever he limited himself to heating it to 100° for only a few minutes. He was no happier in his studies on meat. The milk curdled and bacteria appeared in it, the meat spoiled...

... He was able to crush his opponents, but he could not convince them, because he could not show why in the old experiments as in his own, milk, blood, meat become spoiled, in spite of the absence of airborne germs.

…

Certainly, gentlemen, the difficulty is not to suppose; the difficulty is to disentangle the true from the false, to discover the real. In fact, by all these reasonings, one wanted to explain naturally obscure things by imaginary details; it was adding darkness to darkness without making it less dark...

Lavoisier admirably described this state of mind which leads so many scientists, today as in the past, to reason about hypotheses as if they were proven truths.

## Lavoisier's advice and method

"...it is therefore not surprising that in the physical sciences in general, one has often assumed instead of concluded; that the assumptions, transmitted from age to age, have become more and more imposing by the weight of the authorities they have acquired, and that they have finally been adopted and regarded as fundamental truths, even by very good minds..."

The method which follows from these precepts consists in not paying lip service to them; in not making gratuitous hypotheses; in never proceeding except from the known to the unknown; in constantly taking experience as a guide, in constantly using it to check the views of the mind; in considering the same objects for a long time in order to see them from all their sides; in considering the same fact from all sides, from all points of view, before concluding.....

# 2nd conference

…

It was while pursuing the solution of a problem of pure chemistry that, for the first time, I glimpsed microzymas; that I was put on the way to the researches which I am going to communicate to you and which will make you understand how in the sciences there are often such intimate contacts, that a question of chemistry can be transformed into a subject of high physiology

# Interversion of cane sugar

You know that cane sugar, in aqueous solution, under the influence of powerful acids used in small quantities, slowly when cold, almost instantaneously when boiling, inverts, that is to say that the dextrorotatory solution it was at 15° c., becomes levorotatory at the same temperature; before the reversal it did not reduce the cupropotassium reagent; it reduces it afterwards, because the cane sugar, by fixing the water, by a deep chemical reaction, was transformed into 2 glucoses, of unequal rotatory powers and opposite directions, which compose the reversed sugar.

…< experiments of interversion of cane sugar :

not inverted in zinc or calcium chloride solutions

inverted in distilled water solution with the appearance of moulds p. 47 à 50 >…

… It was in 1855, a great novelty that this simple question :

"Are molds endowed with chemical activity?" ...another one followed immediately, which is this: "What is the origin of the molds that appear in sugar water?

It was in accordance with these concerns that I proposed to institute experiments intended above all to demonstrate the following proposition:

"Cold water modifies cane sugar only so far as molds can develop in the solution, these elementary vegetations then acting as ferments."

And, after more or less successful attempts, on June 25, 1856, I began in Strasbourg, observations that were continued in Montpellier until December 5, 1857...

... See table III <p.52>, a summary of the experiments which interest my subject.

We see there that in the manner of zinc chloride and calcium chloride, the addition of certain salts prevents the interversion of cane sugar, as well as that of a very small quantity of creosote < in fact, phenic acid > or mercury bichloride. This was not the case with arsenous acid or certain salts, under the influence of which the interversion took place, **with or without** the production of molds.

The influence of salts seemed to favor the birth of molds, whether they were neutral like oxalate and nitrate of potash, with an alkaline reaction like sodium phosphate, or with an acid reaction like alumina sulfate....

But the role played by creosote, a substance endowed with such low chemical activity and known as an antiseptic agent, is extremely remarkable; it prevented both the interversion and the birth of molds. It was necessary to determine that there had been nothing there capable of drying up the fecundity of the producing cause of microscopic organisms, infusoria and others. On March 27, 1857, I instituted another series of tests…

…< description experiences over eight months p. 53 à 55>….

It is important to recall that the memorandum in which I recorded these researches was addressed to the Academy of Sciences at the end of 1857 and inserted, by extract, in the reports of the sessions, on January

4, 1858. The complete memorandum appeared 8 months later. These dates have a great importance from the point of view of my quarrels with Mr. Pasteur...

... By its title this memoir is a work of pure chemistry... But soon the question, as I have made it clear, became more complicated; it became at the same time physiological and dependent on the phenomena of fermentation and spontaneous generation...

**And the experiments** that I have just summarized, **I gave them as being contrary to the doctrine of spontaneous generations**... I add that they constituted the first serious attempt to found the physiological theory of fermentation, on which we will insist at length, because it is by this that these studies have much more physiological and medical applications than chemical.

It is by demonstrating that molds are endowed with chemical activity; that they feed, that is to say, assimilate and de-assimilate, that we shall later be able to form a clear idea of the chemical phenomena, absolutely similar, which are accomplished by the most highly organized beings.

…< continuation of the experiments for 6 years until the end of the sugar inversion p.59 à 69 >….

… It is thus shown that the interversion is a function, not of the mold as an organized being, but of a product which it generates in its tissue; absolutely as in the stomach, the digestive function is not an action of the organism directly, but that of a product called gastric juice, and in this juice the result of the activity of pepsin, a substance more or less analogous to diastase. Such is the capital fact which follows from this study...

…< demonstration of the distinction between soluble ferment (the enzyme) and organized ferment (the organism producing the enzyme) p.70 à 72 >….

All this proves that the cause of the interversion of the sugar is pre-formed in the mold and in the yeast; and, as the isolated active matter acts without the presence of an acid, ...It is after having established these facts that I gave a name to this active matter: **I call it zymase**. We will see later how this word zymase, initially intended to designate the active matter of yeast and molds, became a generic term. Today, I refer to the zymase of yeast and molds as zythozymase. It goes without saying that zythozymase, like diastase, loses all its activity by boiling. Now you can see why mold and yeast lose their interfering power by heat.

And I must make the remark: these things were so little known; so little was known of the relationship which links soluble ferments, or zymases, to the organisms which produce them, zythozymase to yeast, for example, that M. Pasteur, three years after the publication of my dissertation of 1857, did not believe in the interverting action of yeast...

...it is important to know that in 1856, in spite of the demonstrations of Cagniard-Latour and the insistence of Turpin, it was not believed that **yeast was organized and fermentation a physiological act**…

…< studies of molds born in various environments p.77 à 79 >….

Sugar water is obviously not the sum of the various materials that can constitute an organized matter, vegetable or animal. Sugar is a soluble substance, which of itself, ..., is preserved indefinitely, even in water and in the air, in a soluble state, without changing its nature or its composition. But solubility and organization are contradictory terms. **Any organism, whatever it is, is endowed with 2 fundamental properties, without which there can be no organization: *insolubility* and *non-volatility*. And this is true not only of the complete being but of the anatomical elements of its tissues**...

...There is no exception: **everything that lives is organized, and everything that is organized is insoluble.**

**…<** physical and chemical conditions for the development and life of molds p.90 à 95 >….

## Reversal cases without mould growth

There were sometimes such and such sugar solutions where the sugar was transformed without me seeing any mold appearing: I was very surprised; but not being able to admit that there could be chemical transformation without a provoking cause, I gave my attention to the very light deposit, most often white, which was at the bottom of the flasks where the reversal took place without any apparent cause. But on examining this deposit, often insignificant, with sufficient magnification, I recognized that it was the small bodies of which I spoke earlier, smaller than anything I had seen until then. Collecting as many of **these little bodies as I could, I found that they were nitrogenous**, and that they could, when isolated and put back into sugar water, change it and act as ferments: this is how I included them in the general term of mold, not knowing where to classify them. It is to the research of their nature, their origin and their properties, that I devoted more than twenty years of my life. I have already told you that **these little bodies were microzymas**. We shall see how I came to give them this name and to relate them to what histologists called molecular granulations, amorphous granulations, etc. It is thanks to the knowledge of their properties that I was able to explain phenomena that Schwann, Schroeder and Dusch, and later M. Pasteur had left unexplained. But for this, it was necessary to create a method different from that of Spallanzani, more or less modified, and whose application cannot be said to kill the reproductive faculty, the productive force of the infused materials.

## The new anti-heterogenic method follows naturally from what I have just explained to you, in accordance with the Memoir of 1857. The experiments of this Memoir had been published for more than a year, when M. Pouchet, ..., raised again the problem of spontaneous generations. When the debate was engaged, I looked for if the method which succeeded so well with pure sugar water or added with various salts would not be applicable in all cases. Such is the object of the experiments which it remains for me to make known to you...

... Here is the continuation of some of the experiments that I successively tried:

Since **it is a question of preventing the germs of the air from intervening**, it goes without saying...

…< germ-free experiments compared according to the new method (creosote = phenic acid), p.97 à 110 >….

… And in conclusion, let me make a remark which applies to all the experiments of this conference, as to those of Mr. Pasteur: it is that they were made, as far as spontaneous generation is concerned, on carefully filtered solutions or infusions. I have not spoken to you about urine, blood, milk or meat; it is that the method using creosote or phenic acid, employed in non-coagulant doses, has not prevented urine from altering, milk from curdling, meat from puttingrefying or at least from undergoing a certain alteration. In these different cases, there are other phenomena to interpret. We will deal with this in the next lecture, after having investigated the true nature of what are called air germs, and among these germs of something that no one has yet considered.

# 3rd conference

…

You will remember that in the last century, Bonnet and Spallanzani assumed that the birth of animalcules and other productions of infusions had a common origin: the living germs, universally spread, in the air, in the waters, in the earth. This was a relative truth, but one of intuition, not of experience; for the existence of these germs had not been demonstrated, at least in its generality, and we have seen that Bonnet readily admitted that they were the product of his imagination, which reason obliged him to admit. But Needham, without further direct evidence, denied the existence of these so-called germs. The modern spontéparistes were more demanding, and Pouchet, ..., tried, by a very large number of microscopic observations, to convince himself of the non-existence of these germs. Messrs. Pasteur, Lemaire and myself have experimentally established the reality of their presence in different places. Well, Pouchet and his collaborators, with the help of arguments that I will make known, denied that these germs had anything to do with the success of their experiments. As for M. Pasteur, **he admits** as proven that any appearance of organisms in infusions or in dead matter has no other cause than these same germs; and this panspermia, he admits, in the same terms, as the producer of all infectious or epidemic diseases! **There are errors there, the fruit of a preconceived system, which I persist in fighting, because they make us lose sight of what is essential, ignoring the true notions of higher physiology concerning the origins of life and organization**.

I have told you how I came to distinguish under the name of small bodies something which I at first confused, under the same name, with the true molds, and which, like these, interchange the sugar cane. These small bodies I found in a multitude of circumstances: in certain calcareous rocks, in some mineral waters and in various environments; we shall see that they exist in the air. It is in connection with a work on chalk that I named them with a name that recalls the organized and living ferments, and designates them as forming a new class of beings: the microzymas. Now, all ferments being of microscopic order, the etymology of the new name is clear: they are the smallest ferments. It is especially to their study that we dedicate these conferences.

After having noticed their presence in my solutions of cane sugar as early as before 1857, it took me 7 years to convince myself of their independent existence, of their functions and of their organized nature. I then discovered them in the air, where no one had not only looked for them, but could not discover them, blinded as we were by false notions of organization. Yet they were known, they were even described under the name of molecular granulations, amorphous matter; but they were considered as unimportant and without significance in the order of organization and functions in the organism. **They were nothing, and I dare to assure you that they are the *whole* of the organization**! Even today, although the reality is obvious, they try to deny it, while making an effort to take it over under other names.

…< experiment of M. Berthelot and Robin: unexplained fermentations sheltered from air germs, with observation of the presence of granulations without attributing any role to them p113 à 115 >

## Analysis of atmospheric dust

… Things had come to this point when M. Pouchet first, then M. Pasteur, searched for the germs of the air: both of them passed by the molecular granulations without seeing them and without giving them any importance.

…< research of the germs of the air of Mr. Pouchet: "he never met neither a single spore, nor a single egg of microzoa, nor any encysted animalcule. » p.115 à 118 >

< Pasteur, using a magnification of x 350, found organized forms between 1/100 mm and 2/1000 mm p.118 à 123 >…

… Well, there is something organized in the air that is much smaller. These are the atmospheric microzymas; something that Mr. Pasteur and all observers have neglected, not to draw, but to describe, but to study. To discover and observe them I use this apparatus...

< description air intake experience p.122 > …

… It must be repeated, what is most abundant are not the spores or the eggs of microzoans which are still to be found, but the microzymas; and it is not by thousands that they are counted in 1.5 l of air, but by hundreds of thousands and more in certain cases...

... But are microzymas germs, spores or eggs of infusoria? Or are they organisms of a very particular order?...

## Notions concerning living matter

...Can we say that a defined organic matter, however complex its molecule, or however numerous the species that we find mixed together, can be considered alive? Or does the idea of life suppose an organization with structure; so that the expression of living matter is synonymous with matter endowed with organization, that is to say with organized matter? It is to these serious questions that one must think when dealing with spontaneous generations.

And if the life supposes organized, structured matter, after the death of the organized being, do the organization and the structure with the life disappear without return? And if the organization is not absolutely destroyed, the life not completely annihilated, where did they take refuge?

These are the important problems raised by microzymas.

*…< views of M. Berthelot, Dujardin, Ch. Robin: experiments of fermentation of mannite. M. Berthelot claims that organization and life have nothing to do with these phenomena and yet he only obtains alcohol in the presence of all types of tissues and animal matter, fibrin, pancreatic tissue, spleen kidney .... But never by replacing them by the most diverse nitrogenous combinations p. 125-126 > …*

… All this is of great importance. We will deduce the consequence that, without the preserved organization of tissues, in what it has of essential, no chemical action would have occurred...

... There was yet another reason why the structure and the particular influence of the tissue were not taken into account; this reason is the following: **it was implicitly admitted** that after death, everything was dead in a corpse; even better, it was supposed that a piece of muscle, or blood, or urine, or milk, removed from a living animal..., have nothing living anymore as long as they do not participate in the life of the whole!

... Mr. Robin saw very right by interpreting very badly...

... One understands why thus Mr. Robin did not see anything alive in certain liquors of Mr. Berthelot, because for him the molecular granulations that the learned chemist had noted... were only amorphous matter without structure.

... M. Ch. Robin called **blastema**, the organized substance, primitive essential, which serves to constitute the tissues. The anatomical elements are supposed to be born from scratch in the blastema. It is a way of spontaneous generation...

... the theory of **protoplasma**, a counterfeit of this one ... is admitted by naturalists as well as by Cl. Bernard. These theories assume, and this is their common defect, that life derives from physical-chemical forces and general properties of matter.

A rival theory, the **cellular theory**, admits that a living organism proceeds from a primitive organized cell, having life in itself; it is stated as follows:

*Omnis cellula e cellula*.

We will discuss it in due course; let me just say that there is something profoundly philosophical in its conception that must be retained; it is the notion that what is alive comes from what is already alive. **But the cell is not what is alive per se; it is, on the contrary, something essentially provisional**.

…

## Molecular granulations

….< p.131 >

Molecular granulations had thus been noticed, some had even attributed to them a certain function in the genesis of cells, but a function that was entirely mechanical... Mr. Charles Robin has even devoted several lessons to their history, distinguishing several kinds; in an article in the Dictionary of Medicine and Surgery < of Littré and Robin>, he gives the following description: "molecular granulations, molecular granules, molecular corpuscles. Very small granulations, formed of organized substance (organized, without structure), from 0.0005 to 0.003 mm wide, which are found either in suspension in all the humours of the body, or interposed in the fibres of the tissues, or included in the substance of the cells, fibres or other anatomical elements, or especially in many amorphous matters. They can be very abundant, especially in the tubercular substance, in the morbid white patches of the serous membranes, in the normal medullary tissue.

I add that in all the treatises and plates of histology and pathological anatomy, these granulations are cited and drawn as a fine dust or in the main form of the drawing...There is even mention of them in the genesis of the cells...They are noted as agitated with a Brownian motion, as are the fatty or pigmentary granulations. And as they are often seen to move within the cell itself which contains them, this interior movement is given as a proof that the cell has a cavity and a distinct wall. Finally, Mr. Robin recalls in the same dictionary that leukocytes and infusoria, while decomposing, let out molecular granulations which offer a Brownian movement with the most intense hopping, and which have sometimes, wrongly, he says, been considered as particular infusorial animals.

... Not only is there no role for them in histology, but nothing is known about their physiological or chemical functions.

... What is certain is that not every molecular granulation is a microzyma, but every microzyma is a molecular granulation. The discovery that I claim as mine is to have brought them out of their obscurity, to have demonstrated:

1. That some of them are ferments of a rare power, and consequently, that they are organized in the sense of structure;
2. That they can, under determined conditions, **evolve physiologically to generate other organisms**, and
3. To have established that, under other conditions, **they can reconstitute cells**.

In short, it is not because they are animated by Brownian motion that I have concluded that they are living and organized beings, but because of all the facts that I am going to enumerate.

…< reflection of different authors on the living matter after death p. 133-134 > …

- In any case, the cadaver being examined histologically after a few days, a little more, a little less, according to the organic centers, the cells disappear; what happens to them and why do they disappear?
- If it is true, as M. Robin assures us, that anatomical elements are born in the blastaemia and if these elements are not the product of a spontaneous generation, what is the cause of this generation?
- If it is true that the protoplasm is the place where cells are formed, in what does life and the faculty of forming cells reside, if one cannot admit that there is living matter without structure?

- All these questions are solved by the careful study of microzymas...

## Chemical activity of molecular granulations

…< **examination of airborne dust, see implementation** p.135 > …

… I use the objective n°7 with immersion of Nachet...

If we pay attention to them < the granulations >, we invariably find that they present themselves with a bright center, endowed with a certain mobility, a sort of trepidation movement, of coming and going. This bright spot, in a certain position, appears as a black spot, but when it is in focus, one has the idea of a sphere whose center is bright with a dark outline. Most of these granulations are less than one thousandth of a millimeter in diameter, but there are some that are barely half a millimeter (0.0005 mm). There are certainly smaller ones. And to have an idea of their smallness... it can ... enter 15 billions in a cubic millimeter, the size of a pinhead. And we find, if the volume of air that has passed through the solution has been at least 3000 liters, that in spite of the great quantity of creosote, without changing their shape, these microzymas, accompanied by some spores that we can meet, are able to invert the sugar cane...

## The microzymas of the chalk < p.136 >

Now, by examining under the microscope the chalk that I used < in various experiments >, it was the commercial chalk (which is called blanc d'Espagne, blanc de Meudon), I invariably discovered in it the same small bodies that I had noted in my other experiments. It took me several years to convince myself that the small bodies of chalk were ferments, therefore organized and alive. Suffice it to say that it was because I had seen them under the microscope, analyzed them and proved their function as ferments that I came to give them the name of microzyma. The first mention was made at the Academy of Sciences and Letters in Montpellier, in 1864 and the Memorandum was published at the Academy of Sciences in 1866, 9 years after the Memorandum on the reversal of sugar water by molds ...

## Microzymas in general < p.137 >

… As early as 1865, I reported them in milk, bringing them closer to those of chalk.

... It results from these researches that microzymas compose the major part, the very great part of the organized corpuscles of the atmosphere, and that, according to the environments where they are forced to live, they produce the organisms which we call ferments.

But before the date of these last works, I was already pointing out in the urine which putrefies, without naming them, the microzymas, under the name of small mobile beings. The same is true of wine: ... as the cause of its aging and alteration.

This is how I came to deal with the **granulations of animal tissues and cells** …

## Chemical action of microzymas

...Let's try to make people understand that microzymas are chemical agents.

One must admit in principle that there is no chemical action without a provoking cause.

...I first admitted that microzymas are living beings because they operate by themselves, chemical actions of fermentation.

…< various experiments including fluidization then fermentation of the starch added with pure carbonate of lime in contact with air p. 139 >…

… But you should not imagine that the microzyma is converted into a bacterium without any transition: on the contrary, there are several intermediate forms between the microzyma and the bacterium... You should

remember that the environment has a great influence on this or that form of the evolution of the microzyma, and that there is a quantity of species as for the function; finally, **that according to the environment, the microzyma can produce cells instead of bacteria, real cellular microphytes and moulds..**.

## Microzymas of higher organisms

To see them, it is enough to take a fragment of organ, an almond embryo, the parenchyma of a leaf, a bit of liver, pancreas, thymus or kidney, a bit of egg yolk; With a scalpel you lightly scrape the fragment in a little water on the microscope's slide, or you dilute a parcel of egg yolk in a little water, you cover the preparation with a thin slide and you look carefully, under a magnification of 500 to 600 diameters (objective 3, eyepiece 2, of Nachet), at the smallest part of the field suitably illuminated In all the preparations, they are very small spheres similar to those described in the dust of the air and in the chalk. If the magnification is more considerable, you will discover there, as in those of the air, a brilliant center and an envelope.

... Let us go straight to the point, and prove by an experiment without replica, their aptitude to be transformed into bacteria.

The pulp of the green and soft parts of the plants is not long in being invaded by myriads of bacteria, of various sizes and, no doubt, of various species. However, this pulp, before the appearance of bacteria, shows under the microscope only cells and molecular granulations.

In order to explain the presence of bacteria, it was thought that airborne germs or spontaneous generation were involved. You will judge of the lack of foundation of these 2 ways of seeing.

In Montpellier, during the cold winter of 1867-68, I had the opportunity to notice two frozen Echinocactus plants. A few weeks after the thaw, I examined the kind of histological alteration that the freezing had caused to the tissues of this plant. Its epidermis did not show any trace of lesion, it was as resistant as before the freezing. Now, you know how hard, thick, resistant and smooth this epidermis is: obviously, the great density of the tissue and the thickness of this epidermis were a sufficient obstacle to the penetration of bacteria, vibrios or their atmospheric germs; you will admit it all the more easily since Mr. Pasteur assures that the body of an animal is impenetrable to these same bacteria or germs. Now, an incision being made in the frozen part, the material, taken from the depth of the wound, or immediately under the epidermal layer, contained bacteria in crowds, where the species called Bacterium termo and putridinis, extremely mobile, were predominant.

This observation was too important for me not to try to verify it.

…< a number of examples are given, the examination was performed 10 to 12 days after thawing, the frozen parts contain bacteria but no more microzymas or microzymas in the process of transformation, the healthy parts contain only cells and microzymas p. 142 – 143 >…

*Fourth example: Agave americana. The frozen and blackened part of the leaf contains no more microzymas, nothing but small bacteria and some longer bacteria of 0.008 to 0.02 mm, all very mobile. In the healthy parts, the microzymas are normal; but as one approaches the frozen parts,* ***one sees the microzymas change in shape and size...***

…< another example of an overwatered plant whose roots were rotten and whose epidermis was covered with molds, the examination of the plant : in the base of the foot, there were only microzymas, of which a small number formed of 2 articles, and thus no invasion had crossed the epidermis p.143 – 144 >…

… It was natural, after what I told you about the influence of the environments for the appearance of this or that organism, to examine, in order to compare them, the chemical state of the frozen environment and the preserved environment. It turned out that the chemical environment changed in most cases.

…< acidic reaction in healthy parts, alkaline reaction most often, but sometimes neutral and even acidic in frozen parts p. 144 >…

Although we think the opposite, bacteria can grow in an acidic environment, remaining acidic or becoming alkaline, as well as in an absolutely neutral environment or remaining neutral...

## Microzymas and bacteria from animals

… It would certainly be permissible to generalize and ... to conclude that animal microzymas possess the same ability as plant microzymas. **I will not do so**, first of all because the question becomes singularly complicated when one considers an animal in comparison with a plant. The latter is in contact with the air only through its external surface, so well protected by the epidermis, whereas the animal admits air and its germs into its lungs, and moreover other openings can be supposed to give them access, not to mention food, drink, etc. Then there is consideration of pathology: without regard to ordinary parasites such as cestoid worms and helminths, there is certainly concern with parasitic diseases due to microscopic parasites. There is, therefore, a very great interest in knowing whether or not bacteria can arise in animal tissues without the contribution of external germs. You are not unaware, moreover, that this is the point of the great debate which is between M. Pasteur and myself.

... in 1865, in a letter to Mr. Dumas, I pointed out that creosote, used in non-coagulating doses, does not prevent milk from curdling later on, nor does chalk transform, without foreign help, sugar and starch into alcohol, acetic acid, lactic acid and butyric acid. From these facts I concluded that chalk and milk contain living beings, the cause of the observed transformations, whose activity was not prevented by creosote. However, the coagulation of milk is accompanied by a development of bacteria, despite the presence of creosote.

I wondered if in the experiments with meat things would not happen as with milk...

…< method of testing the meat protected from airborne germs : development of bacteria, moving sticks and presence of various granulations. p.148 > …

… How can these exceptional results be explained, if not by the presence in the muscles of the living animal, not only of germs, but also of bacteria, at a lower degree of development?

We shall see that we must banish, in the species, the word germ; as for the idea of bacteria at an inferior degree of development, I believe it to be more and more correct; it will make us understand the inanity of the point of view which made one look for the eggs of bacteria!

This method we applied, Mr. Estor and I, to the experiments on the origin and development of bacteria in the **liver, kidney, spleen and pancreas**.

…< experiments applied to the liver p.149 – 150 >…

… These experiments show us that, all things being equal, bacteria appear in the sugar solution much earlier than in the water, and in the starch earlier than in the sugar water. You will also notice that **the appearance of bacteria is preceded by what we have named associated microzymas**.

< Experiment D - Mouse liver after 48h in a bottle of creosote water >…

...We find isolated microzymas, others associated in string; we see microzymas with a large and a small diameter, which progress in the manner of bacteria; finally we also see true bacteria. Many are associated in linear groups of 2 or 3. **Is it not obvious that these are the various forms of the various phases of the evolution of microzymas**?

…< standard experiment, E, in which all causes of error are eliminated p. 151 >…

… Here is a circumstance that convinced us that the bacteria did not come from the outside. In a large number of tests, **these bacteria appeared in the center** of the livers before being visible in the surrounding fluid. Kidneys, pancreas, spleens, placed under the same conditions, but usually more slowly, eventually show bacteria in their center, while the surrounding liquid does not yet contain them.

...We shall see that **fibrin** itself, which is considered a special albuminoid material and an immediate principle, is something that contains microzymas, **the microzymas proper to blood**….

## Degrees of bacterial evolution of microzymas

… At the moment of death of an animal sacrificed in the healthy state, in all tissues, at all ages, **the microzymas are all independent**.

Under the conditions I have just specified, one can catch microzymas coupled to 2 grains, forming strings. Later on, the granulations lengthen so as to present a small and a large diameter; soon these characters become even more accentuated and one has true bacteria, sometimes even true leptothrix, that is to say very long filaments.

... In short, the various vibrios, the chain bacterium, the Bacterium termo, the Bacterium capitatum, the bacteridia, **are only phases of the development of microzymas**, or of certain microzymas, more or less dependent on the nature of the environment. But let us not anticipate, and let us only say that it will be demonstrated that the naturalist cannot distinguish microzymas by a description, because they are morphologically similar; and as size does not constitute, in general, an essential botanical or zoological character, we shall see that they can only be distinguished by their function, which can vary, as M. Joseph Béchamp has demonstrated, for the same gland and the same tissue, with the age of the animal.

Moreover, microzymas and bacteria with the modifications of form that can be observed between the microzyma and the bacterium, can meet, at a given moment, in the intestinal canal, from the mouth and the stomach to the rectum.

... The microzymas of the mouth and its bacteria are other than the microzymas of the stomach, and the latter other than those of the rectum, not morphologically but functionally. It can even happen that the presence of a parasite like the tapeworm, in the intestine, determines some change of the intestinal microzymas and modifies their evolution, so great is the influence of the changes of the environment.

But we will return to all these facts when we deal with the functions of microzymas. For the moment, it is necessary to tell you that these facts were not admitted without contest, especially by Pasteur, whose system they opposed.

... However, it is not that other experimenters have not been concerned with these facts. There are even some who have confirmed them, but without citing the authors of the discovery...

…< extract from an article published by Messrs. Nencki and P. Giacosa ... indicating in particular that other experimenters, Billroth and Tiegel, Burdon Sanderson arrived at the same conclusions p. 154 – 155 >

< reproduction experiments (fermentation protected from airborne germs) by Nencki then Servel p.156 à 158 > …

Let us therefore conclude that there are atmospheric microzymas and geological microzymas, susceptible to evolve into bacteria, as there are physiological microzymas endowed with the same aptitude. There are thus among the bodies that one designated molecular granulations of the currently living organisms. We will search that it is their common origin.

# 4th conference

## Spontaneous coagulation of milk

... With regard to the organized forms which, in their experiments, MM Pouchet and Pasteur have seen, and on the nature of which they did not agree, ..., they are the least numerous; spores or eggs, their origin is very natural as well as simple, and already Spallanzani had known the dissemination of the spores of the mucedinates, as the botanists the transport of the pollen of the flowers. But what Messrs Pasteur and Pouchet did not notice in the ordinary air, or that they let pass without taking care of it, are the molecular granulations, not only of the air, but of the materials that they used in their experiments; these same molecular granulations of which the chemists, the physiologists, the anatomopathologists and the histologists themselves had neglected the study, although they signaled the presence of them in the fermentations that they studied, in the pathological or normal tissues that they described! Well, we have demonstrated that these molecular granulations, first reported under the name of small bodies in certain sugar solutions, could invert the cane sugar and act as a ferment, as well as those that I have observed in certain calcareous rocks and that I have named, because of their function, with a name that reminds us of this function of the ferment: the microzymas. We then acquired the new certainty, that certain molecular granulations, in the vegetable and animal tissues and cells, could generate bacteria, as well as those of the air and the rocks, and we concluded, except to demonstrate it also by their functioning, that they were also microzymas. Finally, you are convinced that I am not the only one to believe in the reality and the value of my demonstrations, since other scientists, warned of the objections made to them, have refuted them by demonstrating that the germs of the air are not the cause of the appearance of bacteria within the most diverse animal tissues: muscles, glands, nervous matter.

...

You remember the experiments of Schwann, Schoeder and Dusch on milk and meat < protected from air germs > : the application of their method of preservation did not prevent milk from curdling and, in certain cases, meat from spoiling. Mr. Pasteur came to the same conclusion: … < p. 163 >

... What is the explanation of these facts? Can the microzyma theory give it? Certainly! Indeed, a new theory has no real value, is the expression of the facts, only if it is able to explain the old difficulties, to solve new ones and to lead to the discovery of new horizons. It will thus be found that the experiments of Schwann, Schoeder and Dusch, of Mr. Pasteur considered carefully, are in their way, a demonstration of the normal existence in milk, of microzymas of a particular category.

< Experiments of Dusch and Gmelin - milk boiled for 2 hours is not curdled - then experiments of Pasteur on milk + carbonate of lime p.163 à 168 >

...In short, M. Pasteur did not concern himself with the histological constitution of milk, nor with the way in which it is formed in the mammary gland: he saw in it only a more or less complex liquid which he studied in the same way as any infusion. You know how I came to give all my attention to animal molecular granulations...

## Histological nature of milk

...These living beings already developed, that is to say having a life of their own, independent, being able to act as ferments, what are they in milk? They are microzymas similar to those of the chalk! We will see later how I isolated them to observe them in a free state; let us only understand why they must necessarily be found in milk.

The secretion of milk normally occurs at the time of parturition. The mammary gland constitutes then an admirable apparatus where profound chemical reactions take place. Casein, for example, nor milk sugar,

nor certain fats, nor other products which we shall discuss, exist in the blood; they are formed in the cells of the gland, which become the seat of transformations which histologists have noted. At the beginning of lactation, the milk is called colostrum; this liquid, whose composition is quite different from milk, contains what are called colostrum corpuscles, namely granular cells which soon disappear; the colostrum may still contain mammary cells or their debris. The glandular cells (of the mammary gland) first become more voluminous, fill with fat and, destroying themselves by a true physiological resorption, dissolve, as it were, completely in the interior of the gland itself; then the fat globules of the milk and the microzymas become free and are found in the product of the milking.

... Finally, let us note that according to the research of M. Dumas, the fat globules are themselves provided with a membranous envelope.

At first I had some difficulty in demonstrating that the microzymas of milk are the sole and primary cause of its coagulation, before any appearance of vibrios or bacteria, so that the problem was not completely solved until 1873.

How I operated: < operating mode p.169 et 170 >

The experiment was repeated several times, always with the same success. By the time coagulation is complete and the whey separated from the cheese and cream is clearly distinguishable, it is impossible to discover anything other than the original microzymas. In an experiment that lasted 15 days, there were isolated microzymas, articulated microzymas and bacteria.

You will notice under which conditions the experiment was performed**: it was in the absolute absence of oxygen**! I have insisted on this in another communication, the results of which I must make known to you, because they are the confirmation and generalization of the preceding experiment, and in general of certain facts concerning microzymas and the general theory of fermentation.

## Alcohol and acetic acid in milk

It is known ... that lactic acid exists in sour milk. ... It is also known that milk can, under certain circumstances, undergo a real alcoholic fermentation: mare's milk, for example, gives koumiss, whey that the Russians and the Tartars consume. But one has never looked for alcohol and acetic acid in milk when it has just coagulated, nor especially when the coagulation is accomplished away from oxygen or air. Now I have constantly found alcohol and acetic acid in significant quantities in my experiments, whether the microzymas have evolved into bacteria or not. But, as you now understand, if the microzymas, during the coagulation of milk, before they have formed bacteria, form alcohol, normal milk must contain it, since in the gland it already contains free microzymas. The assumption has become a reality.

< Experiences p.171 – 172 >

## Alteration of the meat and its products

... You will remember that in the experiment of meat heated in a water bath, without water, and then exposed to calcined air or filtered by cotton, the alteration occurs, without the authors having noted the presence of any infusoria. M. Pasteur also notes this alteration and also believes that it occurs without development of infusoria.

Relying on very well done experiments, but poorly studied and consequently misinterpreted, Mr. Pasteur claims to have proved that "the body of animals is closed in ordinary cases, to the introduction of the germs of inferior beings; from which it follows that "putrefaction will first establish itself on the surface (of the cadaver), then *it will gradually gain the interior of the solid mass*".

... Starting from this hypothesis, Mr. Pasteur ... < p. 173 à 175 >

... All this is pure imagination. Mr. Pasteur, having observed, like his predecessors, some transformation, and not being able to bring in his atmospheric germs, has imaginatively invented the "reaction of solids on liquids, the actions of contact, the actions of diastases" without knowing what the solids are in an organism and without knowing the liquids of which he speaks. And notice that it is a chemist who has been involved in research on fermentations who speaks of contact action in the same way as those who do not admit the physiological action of ferments...

...I affirm that if all the liquids and solids of the same organism were put together, but previously reduced to the state of immediate principles, they would not produce anything similar to what Mr. Pasteur calls *pheasant meat or meat reduced to the state of gangrene*.

...Be that as it may, the observation and the hesitations, the very explanations of M. Pasteur are of great importance; this scientist has observed, in short, that meat or a fruit, detached from the animal or the tree, undergoes some transformations, materially observable, which he could not attribute to the intervention of the germs of the air: the cause of this is entirely internal; the meat, the fruit, carry it in themselves. If therefore we demonstrate that the microzymas of the fruit or of the meat are the transforming agents, it will follow that Mr. Pasteur, in his own way, demonstrates the role of the microzymas...

We know that meat, as well as all tissues, contain microzymas that can evolve into bacteria or vibrios; that milk curdles by the influence of its own microzymas, producing alcohol and acetic acid, and then lactic acid...

I will soon tell you about the microzymas of the liver and the fermentations they determine there. The alteration of meat is a phenomenon of the same order as these; this is the result of the research of M. J. Béchamp which I will make known to you.

< Experiments: alcoholic fermentation of meat, method of J. Béchamp p.177-178 > ...

Mr. J. Béchamp has drawn all the consequences that flowed from his research; he has made the most important toxicological applications of it, pointing out what a serious error would be made if one wanted to conclude from the alcohol of the liquids or tissues of the organism to a poisoning. ... I only add that the author has rightly pointed out that it is probable that in very advanced putrefaction no alcohol would be found: it would have been destroyed by the very microzymas that produced it. In fact, I have long noted that alcohol is perfectly fermentable and that the products of its fermentation are the acids of the formic series, etc. ...

All these facts lead to affirm, in the most certain way, that the animal tissues, to speak as some authors do, contain vibrionian germs. For us the significance is higher; **it is the proof of the existence of microzymas as organisms living with a life of their own, independent**.

## Microzymas and bacteria in living tissue

…. Some time later Mr. Estor published the Note …< p. 180 , for references >

"M. Béchamp and I," says M. Estor, "have addressed to the Academy a note on the evolution of microzymas or normal molecular granulations of animal cells. These microzymas, under the conditions we have specified, group themselves two by two or in greater numbers, then lengthen slightly, finally more, so as to form true bacteria. These facts result from a great number of experiments made on various animals. The following observation shows that **the same transformations can take place in man**. Three days ago, I removed a cyst from a large lip, filled with a greenish, semi-liquid material. An immediate examination, under the microscope, showed microzymas at all periods of their evolution: isolated granulations, others associated, others a little elongated, finally true bacteria."

Mr. Dr. Liouville, at the very time when we were publishing our first studies, demonstrated that the serosity of vesicles contains microzymas, and that these produce bacteria.

Dr. Onimus, in an important work, also showed that vibrionians can appear in the serosa that penetrates the distilled water contained in an ampoule that is inserted under the skin of a living animal.

... You have just seen from what point of view Mr. Pasteur considers gangrene. Here is the cause of its production:

A patient had just had his arm amputated as the result of a severe traumatic injury; the removed part was immediately brought to the laboratory; the forearm presented a dry, black surface, the insensibility of which had been noted before the operation; all the symptoms of gangrene existed; microscopic examination shows us, not bacteria, but associated microzymas, strings. The accident had taken place so quickly that the bacteria had not had time to form, they were only in the process of forming; they are therefore not the cause of the gangrene ... < p. 181 >...

I will give you another example of the presence of evolving microzymas in the organism itself...We looked for evolving microzymas in the tubercular material of a phthisis lung...< observation and analysis p. 182 > ...

...It is thus possible to note, even on the living, in certain pathological states, the existence in the body, in the deep parts, of the various states of the evolution of the microzymas, until the state of bacterium.

## Impenetrability of membranes to vibrios

To many of these facts one can object, and Mr. Pasteur always objects, to the presence of the germs of the air, which one has not avoided. ... Therefore, it is necessary that I show you directly this very real impenetrability...< Chicken egg yolk experiment p.183 >...

... Mr. Eustace and I have had occasion to study moldy eggs in this way: **we have never found the mycelium penetrating the yolk...**

We can therefore demonstrate the impenetrability of a membrane to atmospheric germs. But it is advisable to stop a moment on this consideration of the relation of the living beings with the atmosphere in which all are plunged....

## Relationship of airborne germs

...Mr. Dumas has shown that, in Paris, a man who takes 16 breaths per minute, lets nearly 8 cubic meters of air (8000 liters) enter his lungs per 24 hours.

Now, since M. Pasteur constantly objects, to those who refuse to believe in his multiple panspermia (normal and pathological), to the possible penetration of atmospheric germs and that he admits that they are retained by the infusions and other substances that are exposed to the contact of the air, I have asked for a long time why he does not admit that they are retained equally by the whole surface of the respiratory tract and of this vast humid sheet that the lung supposedly spread out on the surface represents, and do not penetrate there...

... But independently of the air which penetrates through the lungs, there is also that which envelops us, and it is quite certain that the whole surface of the body is covered with a myriad of organized microscopic corpuscles. There is also that which penetrates with the food and drink into the stomach; this air leaves there the greater part of these organized molecules. Finally, the eyes, whose surface is always wet, and other openings, natural or accidental, can be considered as places where microzymas could enter. In fact, Mr. Pasteur assures that the vibrios of the intestinal canal have for origin the germs of the air or the water; he does not see any other! As far as we are concerned, we mainly see vibrios coming from microzymas of our own tissues, of our food, of our drinks.

You can see how complicated the problem is, and how difficult it is to affirm that this or that result must or must not be attributed to airborne germs. The easiest way to do this is to ignore these germs and reduce their influence to nothing....

The question is therefore not whether microzymas penetrate organisms, but whether the microzymas of these organisms currently possess properties that those of the atmosphere do not enjoy...

We already know that, by using phenic acid or creosote, we can prevent the evolution and multiplication of atmospheric germs and preserve unaltered the most alterable materials; we have seen moreover, by experiments on milk, as on molds, that if we can stop the evolution of microzymas, we do not suppress their activity.

... Let me report the experiments that demonstrate the following proposition:

*The influence of atmospheric microzymas on a putrescible material can be made as small as desired or reduced to zero.*

## Suppression of the influence of atmospheric microzymas

< Chalk experiment p.186 – 187 > …

You can see that the microzymas in the atmosphere, which fell into the pure lime carbonate while it was being stirred in the air, and into the yeast broth while it was being mixed, not only did not act, but did not increase. On the contrary, the chalk, which contains a host of microzymas, increased in weight, because these microzymas swarmed and partially transformed! They have more than tripled! < Control experience p.187 – 188 > …

You can now see why Mr. Pasteur saw bacteria appear in the infusion of sweet yeast with chalk added. If he had used pure carbonate of lime, he would certainly not have been obliged to heat his mixture under pressure.

Thus, in the experiments in which Mr. Pasteur so easily sees vibrionians appear, creosote or phenic acid are absolutely opposed to their appearance when the substances put in experiment do not already contain the microzymas which produce them....

Having said that, let us compare the multiplication of microzymas of chalk in the sweet yeast broth with the multiplication of microzymas in the body.

...The liver is one of the glands where a very active proliferation of molecular granulations occurs. I find in the works of Cl. Bernard a precious information on this subject. The illustrious physiologist noted that in rabbits digesting carrots and bread, and in dogs digesting starchy foods, the cells of the liver are turgid, rounded and surrounded "by myriads of small molecules animated by an excessively rapid Brownian motion." On the contrary, in the fasting animal the cells are not surrounded by molecular granulations, the edges of these cells are very sharp, and they are as flattened in the fasting rabbit.....< p. 189, for references > … We will come back to this very interesting observation, when we will deal with the physiological and chemical functioning, even histological, of microzymas.

## Physiological death of a bacterium or a cell

In the third lecture, I told you that shortly after an animal dies, the cells of the organs disappear. What happens to them? In their place we discover a multitude of molecular granulations! The destruction of a cell is obviously death, more than the death of that cell. In this respect, I wondered what the death of a cell could be, and also that of a bacterium or a vibrio. And we will see it later, this connection is not random, because we will demonstrate that **microzymas produce bacteria and vibrios by evolution, they produce**

**cells by construction**. Well, the physiological end of a cell is its dissolution, its regression, its return to the formative microzymas: when the cell is destroyed, the microzymas remain. It is the same for the bacteria: **when the bacteria disappear, the microzymas reappear**.

In the stomach of a digesting dog, there are bacteria that physiologically pass with the digested products into the small intestine; a little beyond the pylorus there are no more, there are only microzymas; but the bacteria reappear in the large intestine and even a little before ....

## Microzymas at different ages

Mr. J. Béchamp proposed to investigate if the microzymas were functionally the same at different ages of the same being, from the fetal state to the adult state; and what could be their chemical function at different ages in the same organic center.

…< Method on egg yolk microzymas p.191-192 >…

At that time ... only the microzymas of the liver and pancreas were known to be functionally different ...

The author has operated on the muscles, lung, brain and glands, at various ages from the fetal state, of certain animals and man...

… < Sampling method p.192-193 > …

...when it comes to studying the chemical function of a tissue or an organ, there are 3 things to consider:

1. Their soluble albuminoid material without chemical function ;
2. Their zymases ;
3. Their insoluble part, in which it is still necessary to consider the anatomical element and the immediate organic principles which constitute it.

…< explanation of the technique on a muscle p.193 – 195 > …

We will return, in another lecture, to the chemical functions of the microzymas of the various tissues. We will deal mainly with their unequal ability to evolve into bacteria, either in starch or in sugar water.

< Results of the experiments >

...The germs in the air had absolutely no influence on the observed phenomena.

...Let us consider in each series successively the non-glandular tissues and the glands.

*Muscle.*

- In the starch, the bacteria always appear, but with more difficulty in the experiment where fetal muscle is used.
- In the cane sugar solution, the bacteria appear more slowly, and one can easily follow the various phases of their evolution; with the fetal muscle, it can happen that the appearance of bacteria is not observed and that the associated microzymas exist alone.

*Lung*.

- Things happen in much the same way as they do with muscle, in starch and in sugar water. It even seems that the bacteria appear more slowly.
- For the fetal calf lung in sugar water, the 3 and 4 month old lungs gave only associated microzymas without bacteria.

*Brain*.

The brain matter provided some very noteworthy results.

- The adult one, in the starch, does not give bacteria, the evolution stops at the associated microzymas.
- The cerebral matter of the fetus of calf does not give either bacteria, but a little more easily of associated microzymas.

In these experiments as in the following ones, everything was similar as quantity of tissue..., temperature..., and the microscopic observations were made in the same time...

With the brain matter, although real putrefaction phenomena appeared, bacteria did not appear at any time...

On the other hand, is it not remarkable that the lung, whose contact with the air takes place over such a large surface, did not allow bacteria to appear more easily than the muscle, for example? I will try to explain this fact.

...All things being equal, the microzymas of glands evolve more easily into bacteria than those of non-glandular tissues.

*The liver*.

- The liver produces bacteria with the greatest facility, and it has been noted that evolution is slower in sugar water.
- Microzymas from the calf fetus, at 3 or 4 months, in sugar water, did not yield bacteria; evolution appeared to stop at the associated microzymas.

*The pancreas*.

> The pancreas is about the same as the liver. It should be noted that bacteria there often acquire the length of leptothrix.

Salivary glands.

> These glands presented this particularity to give easily birth to bacteridia (immobile bacteria) and leptothrix (very long immobile bacteria)

...Finally, all this, with a few nuances, is true with human tissues... You will notice that the human fetal brain produces bacteria in starch, more easily for the younger fetus. The ability to produce bacteria decreases with the age of the fetus, so that the brain matter, at the age of 6 months, produces only slightly elongated associated microzymas, without real bacteria, and that of adult produces only associated microzymas.

Concerning the bacterial evolution of microzymas, M. J. Béchamp noticed ... that it is incomparably easier in the starch than in any other medium .... That the transformation of microzymas into bacteria was more easily done in the tissues of adults, and, on this subject, he recalls that it is **the microzymas of the egg yolk which undergo this evolution with the greatest difficulty.**..

...I do not want to miss the opportunity to point out an important verification. We have seen that Mr. Estor found bacteria and the various phases of the evolution of microzymas in the material of a cyst, examined at the time of its opening.

It is, in the first place, the placenta of an abortion arrived at the fifth month of the pregnancy .... In short, the tissue of the placenta behaved like an adult tissue, coming very close to the way of being of the liver, which is in agreement with certain observations of Cl. Bernard, who, having found glucose in the placenta, brought it closer as regards this function, to the liver itself.

Secondly, it is a fetus from a 6-month-old abortion. It had remained, 12 days after its death in the uterus. It was in a state known as macerated; it showed no trace of putrefaction, exhaling only a bland odor; all its tissues were considerably congested and flaccid. At the time of starting the experiments, the histological

state of the tissues is examined under the microscope, from the point of view of the conservation of the cells and the state of the microzymas.

*Muscle* (pectoralis major).

In the tissue, associated microzymas and rare small bacteria.

*Liver.*

All clean cells have disappeared; only the nuclei, many free microzymas and a few small bacteria, including bacterium termo.

*Lung and heart*.

Nothing to note

*Pancréas.*

Associated microzymas and termo bacterium.

*Thymus.*

Rare associated microzymas.

*Spleen.*

Nothing to note

The tissues of this fetus contained bacteria although they had not had contact with the air.

We shall return in another lecture to another facet of M. J. Béchamp's studies, having to do especially with the purely chemical function of the molecular granulations of the adult or fetal tissues he examined. For an infinite number of secondary details, the thesis is to be consulted < Réf. p. 199 >. The author insists at every moment on the evidence establishing that the results he has recorded are absolutely independent of atmospheric germs. It is really so, and you see by all these accumulated facts, that **when the animal dies, something living**, in the chemical sense, **persists in the corpse: the microzyma**.

…< Heterogenist systems - ancient and modern - that of Buffon - of Pouchet … p. 200 à 217 > …

# 5th conference

The tissues of all living beings, from the largest tree to the smallest mold, from man to the humblest animal, contain microzymas that can, by evolution, produce bacteria.

… < Conflict of interpretations between Pasteur (physicochemical reaction) and heterogenists (spontaneous generation), while all of them obtain the same experimental results without ever noticing or giving importance to granulations p.219 à 222 > …

… We will devote this session to demonstrate that microzymas of any origin are by themselves, ferments of the order of organized ferments.

… < Clarification on the use of phenic acid, p.222 à 224 > …

## Atmospheric microzymas are not killed by creosote

Let's start with the microzymas and airborne germs. If creosote or phenic acid kills them, they will not have to transform the cane sugar and not ferment it.

… < experiment with sweetened and creosote-treated water through an air stream of 3000 l - result eight days after the air stream has stopped p.224-225 > ….

... Granulations of less than a thousandth of a millimeter could be seen. There was not a single bacterium ...

What happened to the sugar water? Its reaction was obviously acidic...

So creosote does not kill airborne germs: the beginning of fermentation puts this fact beyond doubt. And if in my first experiments the same agent prevented the reversal of the sugar cane, it was not for killing these germs, but for stopping their evolution and multiplication...

The experiments on chalk also lead to the conclusion that creosote is not lethal for microzymas, since chalk alone, in spite of its presence, can operate the alcoholic, acetic, lactic and butyric fermentation of cane sugar and starch; however, there too, the microzymas keep their shape, i.e. do not evolve, if the desired conditions are realized... so that the antiseptic agent does not hinder the fermentation, it is necessary that the quantity of this chalk, i.e. of the microzymas, is considerable, so that the phenomenon can be measured.

It has been claimed that the activity of the microzymatic chalk as a ferment is due to the atmospheric germs. But one wants to forget that chemically pure lime carbonate, used in the same conditions, remains absolutely inactive. Moreover, chalk itself becomes inactive as soon as it is subjected to the action of a sufficiently high temperature; finally, ..., all the limestones with microzymas do not possess the same properties as certain samples of chalk... we will come back to this when we investigate the origin of the microzymas of these limestones, as well as those of the atmosphere.

Besides, I did not conclude to the existence of geological microzymas only from the chemical activity of the rocks which contain them. I have isolated them.

…< technique to isolate microzymas p.226 > …

... it is enough to incinerate; the loss expresses the organic matter of the microzymas; finally the elementary analysis makes it possible to prove that this matter contains the carbon, the hydrogen and the nitrogen that any organized ferment must contain.

... the microzymas of certain limestones can operate much more difficult fermentations, since in the presence of an animal matter which serves them as food, the musculin, for example, they are able to ferment alcohol itself. We will come back to all this.

... Creosote is lethal in coagulating doses, it is not lethal in non-coagulating doses; but it can be considered as a moderator of the double property of microzymas to produce bacteria and to be ferments.

Let us now see how it is possible to isolate microzymas from animals and plants in order to study them in their state of freedom, their properties, their composition and their functions.

## The microzymas of the Liver

… I will tell you in some detail how to isolate the microzymas, and then we will apply the process to other glands.

…< technique to isolate liver microzymas p.227-228 > …

... After these long treatments, the microzymas were found unaltered; their shape and mobility had remained the same.

...I also separated the microzymas from the non-hydrotomized liver: they are apparently the same, at least morphologically; but the chemical composition seemed to me to be a little different, probably because in this case they can be contaminated by the microzymas of the blood which I will talk about later.

Isolated, ... **the liver microzymas are in the state in which they function in the gland itself**.

…< other preparation details p.229 > …

At the time when we first isolated animal molecular granulations to study them outside the tissues, we had to distinguish them from other granulations identical in form. The authors, we said, sometimes consider them as being fatty granulations; some, remaining silent on their nature, limit themselves to representing them as endowed with a Brownian motion. For us, we characterized them by saying that, to see them distinctly, as small spheres, it is necessary to have a magnification of nearly 600 diameters; that they are insoluble in acetic acid and in caustic potash to the tenth, as well as in ether, which excludes their greasy and albuminous nature; and we added: water does not alter them in any way; even after several contacts; **they are, in a way, rot-proof**. The movement of trepidation, called Brownian, belongs to them.

## The microzymas of the pancreas

The way to extract microzymas from the pancreas is basically the same, but it requires much more care because of their special activity. The operation is only successful at low temperatures...

…< precision on the technique to isolate microzymas from the pancreas p.230 > …

… The filtered liquids are used for the preparation of pancreazymase (Cl. Bernard's pancreatin).

...

...We end up collecting, on a filter, a mass, similar to the one you have in front of you, which has the appearance of beautiful blond yeast: it is formed of microzymas such as they exist in the gland. Under the microscope, it resolves itself into a host of small, rather large spheres, larger than the pure microzymas as we are about to obtain them. In this state, they already possess the chemical properties that we will recognize.

But as you see them, they are not pure, they are embedded in a layer of fatty substances, which forms a thick atmosphere for them: this is what made us believe that the molecular granulations of the pancreas were fatty granulations.

… < fine extraction technique p. 231 > …

... After another wash with water, which removes all traces of leucine, tyrosine, xanthine, hypoxanthine, etc., the microzymas can be considered pure. Under the microscope, **they appear much smaller than those of the liver**; they are certainly less than 0.0005 mm in diameter. In spite of the length of the treatment, no trace of bacteria and hardly any associated microzymas are found; it is however difficult to separate absolutely some debris of cell membranes and bodies of crystallized appearance.

These microzymas present this particular character, that in spite of the washing with ether, the most prolonged and the desiccation in the fastest vacuum, they always join together in a rather hard brown mass, and as horny. In mass and wet, their color is olive brown, grayish.

Twenty beef pancreases provide more than 130 grams of moist, well-drained microzymas, containing about 12% dry matter.

## Microzymas of various glands and organs

In this way, I extracted microzymas from the thymus, the spleen and the kidney.

The stomach microzymas, I first isolated from the mucus which flows at the same time as the gastric juice, from the stomach of a dog with gastric fistula and fasting. This mucus is formed by the debris of cells of the stomach glands and a host of microzymas...

... < extraction technique p.232 > ...

... Gastric microzymas are very small. I will discuss later the extraction of microzymas from the stomach glands themselves.

A similar procedure can be applied to isolate microzymas from the intestinal canal, either fasting or while the animal is digesting.

And it also applies to the isolation of microzymas from barley, wheat, almonds, hazelnuts, etc.

## Microzymas of almonds or hazelnuts

...< technique for the isolation of microzymas from cotyledons and embryos (separately) of almonds p.232 >...

... But the process is not applicable to all cases, for example to gastric gland microzymas and fibrin.

## Microzymas of fibrin and blood

It may seem strange to hear me talk about the microzymas of fibrin. This substance, which is extracted from blood, is considered to be a special albuminoid material, an immediate principle comparable to musculin. This is not the case. And as the matter is of importance as much from the point of view of the history of microzymas as from that of blood, it is necessary that I tell you how we arrived, Mr. Estor and I, to look at fibrin as a sort of false membrane containing microzymas of a particular species.

The demonstration involves several kinds of experiments - and to follow the order we have adopted, I will first prove to you that fibrin, like milk, meat, liver and other tissues or glands, can under certain conditions let bacteria appear.

The study we are about to undertake will have yet another object: the research and the cause which determines the formation of fibrin; this will lead us to the discovery of the microzymas of blood and their properties.

...< mise en œuvre – étude des microzymas de la fibrine (sang veineux et artériel d'un animal jeune) p.233-234>...

… The starch is rapidly fluidized, often after five to six hours, twelve to twenty-four hours at most. And, notice it well, fluidization generally precedes any appearance of forms other than the microzymas; the fibrin disintegrates more and more: in its place we soon find all the intermediate states between the microzyma and the bacterium.

In sugar water, we find that the interversion follows the evolution of microzymas, ..., the evolution is slower than in the starch.

The presence of carbonate of lime has the effect of accelerating the fluidization of the starch and the bacterial evolution of the microzymas.

...

Physiologists have long recognized that fibrin is not identically endowed with the same properties depending on whether it comes from venous or arterial blood; from the blood of such and such a region of a very young animal or of an adult animal.

...

In most cases, especially when the fibrin is supplied by a very young animal, its disappearance is so rapid that it is difficult to follow the phases of transformation of the microzymas. We looked for a way to slow down the phenomenon, and **we found that the microzymas in fibrin may not be killed by heat at the temperature of boiling water**.

…< Experimental fibrin analysis of venous blood from a dog in starch p.235 > …

**… Fibrin allows the appearance of bacteria and the forms that precede them: it therefore contains microzymas;** and this experiment shows us that it is constituted in the manner of **a false membrane woven of microzymas joined together by a special albuminoid material...**

**...** We will see that the vegetable production called Mother of vinegar reminds, by its constitution, the fibrin; it is also a membrane with microzymas showing in the same circumstances similar phenomena. The glairine of Molitg is similarly a natural production whose whole organization resides in the microzymas.…< p. 236-237 > …

… Fibrin was considered by chemists to be an immediately defined active principle, which was for a long time confused with muscle fibrin. However, muscle fibrin dissolves easily and instantaneously in hydrochloric acid to the thousandth. ... The same is not true of blood fibrin.

… < experience p. 238 > …

… These are the isolated fibrin microzymas. Let's prove that they are the direct cause of the fluidification of the starch.

… < experience p. 238 > …

Fibrin microzymas therefore reproduce 2 essential properties of this substance: that of fluidizing the starch and producing bacteria.

They reproduce a third one...

... Indeed, when these microzymas are introduced into hydrogen peroxide, ..., one immediately notices an abundant release of oxygen which seems to come out of the particles of the mass. When the microzymas have been well separated ... the decomposition of hydrogen peroxide is even more active than by fibrin itself under the same conditions.

… < study of microzymas and other fibrin compounds p. 239-242 > …

... The conclusion is legitimate: **the fibrin of blood is a false membrane which contains microzymas, and these give it the properties that we know**.

We will explain later how microzymas intervene in the dissolution of fibrin by the very extensive hydrochloric acid. We will prove that this fluidization is a function of the activity of microzymas.

## Blood microzymas

… It could not be that the blood does not contain microzymas, since it is a liquid in which, necessarily, are always 2 cellular anatomical elements: red cells or hematies and white cells or leucocytes. There is, in fact, in the blood of all the animals we have examined ..., an innumerable number of mobile molecular granulations, having all the characteristics of microzymas...

But, you understand it well now: for the observation to be conclusive, it is necessary that it relates to the blood at the moment when it leaves the vessels, before the formation of the clot, i.e. before they were used to form the fibrin and especially on blood which one knows to give little of this substance; the blood of very young animals is in this case...

In the middle of the globules, we always see a lot of microzymas. **They are quite similar to those of the liver, but smaller and more transparent**. It is their tenuousness and transparency that has prevented histologists from seeing them. Moreover, because of their smallness, it is useful to use the immersion lens, n°7 of Nachet. ... In the blood defibrinated by the beating, almost all the microzymas have disappeared. They are difficult to see in blood mixed with water. But after their action on starch or sugar water and their evolution in strings of 2 to 20 grains, they are positively insoluble...

**The blood, contrary to what we thought, does not contain only two histological forms: the microzymas are the third organized element of the blood**.

But do blood cells contain microzymas? Mr. Estor and I answered in the affirmative.

… < decomposed or crushed globule experience p.244 > …

... the globules are torn apart, and the microzymas, now free, swim in the liquid with their own oscillatory movement.

But if it is easy to see the microzymas of the blood, it is very difficult to isolate and to study separately those of the globules, either that the water alters or deforms them.

In any case, **the microzymas of the blood cells are those which produce bacteria with difficulty**.

… < experiment on red blood cell microzymas p.245 > …

…

…, we do not take enough account of the action of the glands on the blood which passes through them. These glands, besides having their own structure, contain in their cells, or in a state of freedom, microzymas, whose functions we shall learn to know. Now, these microzymas necessarily exert a chemical action on one or the other of the materials that the blood brings there; the microzymas of the blood themselves, by undergoing, like the globules, the influence of the new environment, can acquire new functions which will be manifested, at the exit of the gland, by new properties of the blood which contains them; because do not forget it, **the microzymas summarize in themselves what there is of essential in the chemical operation of a given cell or mood**.

… < blood microzymas before and after the liver p.247 > …

… the blood cells of the susepatic blood are significantly smaller than those of the portal blood.

... The leukocytes increase in the susepatic veins; ...

... You see there that the liver exerts a certain action on the incoming blood; ... but I cannot return to the observation already made concerning the influence of digestion on the increase of microzymas in the liver. You will recall the two figures by Cl. Bernard concerning the histological state of the liver in the state of

abstinence and in the state of digestion of starchy foods. "When, he says, one examines under the microscope the liver of an animal digesting starchy substances, one sees in the hepatic cells an infinity of small globules of fat; around these cells are spread myriads of small molecules, which also offer the appearance of fatty matter, and which are animated by an excessively rapid Brownian motion". We know that these molecular granulations that Cl. Bernard took for fat, are the microzymas of the liver. However, in the state of abstinence, these microzymas are no longer found, or are found less. What happened to them? The authors are not concerned about this!

And the case of the liver is not isolated...

## Blood fibrin and its varieties

... < p.248 à 250 > ...

These considerations suggest that blood coagulation and fibrin formation are immediately dependent on microzymas. And here is an experiment which shows us a production more or less similar to fibrin forming only in a liquid where microzymas have been left...

... < p.251 à 252 > ...

## New blood experiments

...< Pasteur's experiment, blood kept for eleven years, in open vases, without any bacteria being observed p.252 > ...

... I answered that blood was one of the liquids where bacteria appear with the greatest difficulty and that the lung, the organ that is most directly in contact with the air, is, after death, the viscera that putrefies last; all forensic doctors know this...

I added this: "But how does the absence of bacteria and putrid odor in the experiment that Mr. Balard has put forward prove that there has been no change? Recently, M. Pasteur invoked again this famous experiment in his book on beer. We will examine it later, and you will judge with knowledge that this experiment verifies the theory of microzyma.

I have already spoken about the evolution of blood microzymas into bacteria. Here is a series of experiments that I did in Montpellier in September 1873. They are intended to demonstrate that **the environment has a considerable influence on the evolution of microzymas and on the more or less prolonged conservation of the red blood cell.**

...< a number of preparations are observed and studied every day p.253 à 260 >

... I have not hesitated to give you all these details in order to convince you **that blood is one of the liquids or animal tissues in which bacteria appear with the greatest difficulty,** under any conditions, except in carbonic acid. All the experiments I have cited prove that the microzymas of blood are of a special kind. However, we have found differences depending on the animal and on the region of the vascular system from which the blood comes .... What we must remember from all this is that the air, whose contact was not avoided, whose intervention was even exaggerated in some experiments, has nothing to do with the observed phenomena, except a conservative influence...

What we must remember from these experiments is that blood is an extremely variable mixture, a product of the organism in which all the vicissitudes of nutrition and of the various conditions to which an organism may be subjected resound. And these considerations have a major importance in pathology: it can happen that the microzymas are placed, during life, in such conditions that they evolve to give bacteria in the vessels themselves, which undoubtedly coincides with a change of function..

... < Pasteur's blood "conservation" experiment p.261-262 > ...

...This is the result. I ask you, is this preserved blood? Without doubt, there is no smell of putrefaction properly speaking, that is to say the horrible smell of really putrefied blood, but it takes on an odor of lye; but it changes color, but crystals are produced; but the globules disappear, but there is oxidation. And undoubtedly, if Mr. Pasteur had pushed the analysis further, he would have found other products of fermentation. The author did not see any bacteria in it; but we know that he did not see any in the meat that was prepared, as he put it. I am willing that Mr. Pasteur did not see long bacteria, of those that everyone can distinguish; but he neglected, because he did not see them, or because he looked at them without meaning, the molecular granulations, isolated or coupled... ... **It is with lightness that Mr. Pasteur concludes in such a serious matter**: he acts exactly as in his studies on milk, on meat, and, we will have to come back to it, on urine.…

## The microzymas of the egg yolk

…< experiences and descriptions p.263 à 266 > …

There are therefore microzymas in the egg; they are rare in the white, innumerable in the yolk.

...The microzymas of the yolk, isolated, or in the presence of the materials which accompany them, put in creosote starch in non-coagulating doses, or in sugar water, do not produce bacteria, except accidentally; and when the phenomenon occurs, it is always possible to see that it is preceded by associated microzymas.

In short, the tissues and fluids of the organism all contain, without exception, molecular granulations of the order of microzymas; and these microzymas, with unequal abilities, are capable of producing vibrionians. So far we have studied only this side of their history and the art of isolating them. We will now study them from the point of view of their functioning as ferments and thus legitimize, better than we have done up to now, the name we have given them.

# 6th conference

## Theory of fermentation

..." The microzyma is organized and alive like the germ that produces the embryo. But their vitality and organization are denied, maintaining that the bacteria which come from them are the fruit of spontaneous generation. This denial, as we shall see, is due to the state of science: **we do not know what living matter is.**

**The study of microzymas will allow us to penetrate the mystery.**

... The term "germs" does not apply to microzymas, they are not like eggs, vibrio eggs or bacteria that need fertilization to multiply.

*… < History of science ...point of view in 1856 of M.Gerhard "...organized beings are never the determining causes of fermentations or putrefactions p. 269 à 275 »*

…. It is in this state of mind of science ... that I undertook my experiments on the interversion of cane sugar in solutions exposed to air < 1st conference > I was demonstrating 3 things:

1. That interversion is produced by several species of molds and by the small bodies that I later named microzymas ;
2. That the interversion was consecutive to the development of the molds and that an acid was formed at the same time;
3. That the direct cause of the interversion was due to a soluble substance analogous to diastase, and I named it .... Zymase.

... These three points contain the entire physiological theory of fermentation, as I developed it later, and whose significance Mr. Pasteur has not yet understood, as I will show you ... Here is the statement of this theory: instead of saying that fermentation is an effect of the vegetation of yeast, as Cagniard-Latour and later Mr. Pasteur expressed it, I, inspired by the ideas and a luminous statement of Mr. Dumas, considered alcoholic fermentation as a phenomenon of nutrition. Instead of saying that fermentation is an effect of the vegetation of the yeast, as Cagniard-Latour and later M. Pasteur expressed it, and inspired by the ideas and a luminous statement of M. Dumas, I considered alcoholic fermentation as a **phenomenon of nutrition**, based on precise experiments. The yeast digests the cane sugar by means of zymase; it **assimilates** the glucose formed and **de-assimilates** alcohol, acetic acid, carbonic acid and the products found in the residue of the distillation of the fermented liquid, products among which M. Pasteur had the glory of discovering glycerine and, after a German chemist, succinic acid.

....

Mr. Pasteur, and I before him, started from the point of view that the germs of all ferments exist in the air; that all the phenomena of fermentation and putrefaction recognize these same germs.

Now, in 1863, ....

.... I asked myself if it was true, as I had taught until then, that a phenomenon as constant as the fermentation of wine, was left to the chance of the germs in the air. The difference in the fermented products obtained ... made me wonder if the grape would not carry the germs of the ferments that make wine.

...

...It was necessary to fight against two deep-rooted errors:

**- The error that attributes to air through its germs too great a generality of action**

**- And the error which attributes to oxygen the production of the ferment...**

… < Successive explanations of Pasteur's errors in the implementation of his experiments, repeated by others p.277 à 283 > …

… I am, in scientific matters, of the sentiment of Boileau in matters of poetry

*Make haste slowly; without losing courage,*

*Twenty times on the job put your work back,*

and I do not publish an experiment until I have remembered twenty times the precept of Lavoisier that I quoted to you < see foreword >.

… We will study microzymas from the point of view from which we consider brewer's yeast and other organized ferments, i.e. in themselves, as agents capable of carrying out chemical transformations. We will then see that, independently of this chemical function, they have another which can be considered as being of a physiological and histological nature.

Their chemical function in the isolated state or contained in the separate tissue of the animal, which is of the order of that of the organized ferments, will explain the role they play during life, in the tissues, in the glands or in the organism itself, whether they conserve their form or evolve into bacteria.

... Chemists call a ferment a nitrogenous organic matter of the albuminoid order capable of producing some chemical transformation in a given organic matter. They then distinguished two orders of ferments: insoluble and soluble ferments. Brewer's yeast was the type of the insoluble ones, diastase, of the soluble ones...

... Today everyone recognizes that the insoluble ferments are all organized.

But we persist in considering the activity of the one and the other from the same point of view.

.... The link of dependence exists so well that you can affirm this:

**Every soluble ferment presupposes an organized ferment** (yeast-like cells, bacteria, microzyma) that generates it.

I have all the more the obligation to demonstrate this proposition to you that it was explicitly contested, denied by Mr. Pasteur...

.... < Experiment p.286 and 287 yeast on cane sugar>...

There are thus 2 functions of yeast that are independent of each other, the interverting function is accomplished outside of the yeast, without its direct assistance, the other, the function of alcoholic fermentation imperiously requires its presence.

.... But maybe this is only true for yeast? Think again. Here are ferments of very different origin, since they are of animal origin, and even more, of human origin! On this filter we have filtered the oral saliva of a man. The filter has retained microzymas, bacteria, leptothrix and some epithelial or mucus cells ....

…<experience p.288 human saliva - starch starch at the 25th >

… the phenomenon of fluidization and saccharification of the starch was followed by acid fermentation

.... **And all the organized ferments, without exception, up to the microzymas, have these 2 distinct and independent functions**.

....

The organized ferments have two functions*:*

- *A chemical function which is exerted outside by their zymase;*

- *A nutritional function*

< Demonstration of the first function: action of zymases or soluble ferments (diastase) compared to chemical agent (sulfuric acid) p.289-290 >

... It is clear that zymases are purely chemical agents, whose activity in certain circumstances, can be supplemented by those of acids and heat.

.... The other function, which I call the nutrition function, what does it consist of? What can be the function of nutrition in an organized ferment, in a being reduced to the most elementary state of a cell?

These are very important and delicate questions that touch the highest regions of physiology.

.... We know that the brewer who introduces the necessary quantity of yeast into the wort harvests 6 to 7 times more. Cagniard-Latour and Turpin said that the yeast thus sown was nourished in this environment favorable to its multiplication.

.... I have demonstrated .... That the yeast, diluted in pure water, gave off carbonic acid and formed alcohol and acetic acid, etc. But these products came from yeast, which was shown to be free of sugar ....

This is the physiological theory. It is necessary to distinguish two circumstances in the nutrition of a being: that in which all the food it needs for the regular accomplishment of this necessary act is supplied to it, and that in which one of these foods is denied to it.

.... The same is true of yeast, which, when given only sugar, does not multiply in number and weight, but decreases in weight. In order for it to multiply in number and weight, it must be given at the same time what it finds in the brewer's wort, that is, in addition to glucose, appropriate albuminoid and mineral matter.

...< follows a dispute between Pasteur and Béchamp, Pasteur defending the "contact" theory: it is the contact of the yeast that operates the decomposition, since sugar does not penetrate the yeast according to his disciples and himself >

.... In any case, I note a permanent activity in yeast: it lives, even when we do not feed it; just as an animal lives, more or less long when we deprive it of food. These are solidly established facts.

< This is followed by a demonstration of the penetration of food into the yeast p.297-299 >

… < last remark on zymases >. And this is the marvelous harmony: the acids would have produced dreadful disorders where the **zymases act with a physiological softness** < generally at a temperature of 37 to 40°C> **worthy of the greatest attention and which provokes astonishment**.

## Chemical function of microzymas

... We will find, as for the other organized ferments, that they can have a zymasic function and a nutrition function...

….

### The microzymas of the liver (dog or rabbit, fasting or digesting) are able to fluidify the starch starch, but without saccharifying it...

... Cl. Bernard had observed that a well hydrotomized liver, containing no more glucose, would contain glucose 24 hours later, if left to its own devices. And he concluded with reason, that the glucogenic material, after a certain time, reproduced the glucose that the washing removed.... If it is a zymase, who produces it?

… < experience p.302- 303 > …

## The microzymas of the pancreas

….

- - Operate the transformation of the starch by keeping their shape, it is only after a prolonged stay that they evolve into very small linear bacteria and strings of grains or 8 ...
- - ... are without action on the cane sugar ....
- Action on fats .... Eventually reddens the blue litmus paper <So acidic - Still to be studied>
- Action on animal materials - But the most remarkable property of these microzymas, is to dissolve and transform deeply the most diverse albuminoid materials <beef blood fibrin, fibrinin, musculin, casein ...> - ... among these substances, the insoluble ones are rapidly dissolved or, as we say, digested and transformed... The soluble ones are deeply modified and transformed too...
- Let us first insist on the fact of the dissolution of the insoluble albuminoid substances:< demonstration with fibrin p.308>

  … I throw it on a filter, a liquid flows out which contains all the transformed fibrin, minus its microzymas, which remain mixed with the pancreatic microzymas. I will tell you later about the subsequent influence of the fibrin microzymas on the mixture resulting from the reaction.

  ... You will recall that fibrin swells before dissolving in the very extensive hydrochloric acid. The phenomenon is quite different in the present case: the fibrin disintegrates and disappears without any swelling…..

## Gastric microzymas and stomach gland microzymas

We have just seen that the pancreatic microzymas operate the same transformations as the pancreatic juice and moreover, that the products of these digestions: albuminoses, fibrinoses..., **are not the same** as those obtained from albuminoid substances by the action of gastric juice…..

### Action of gastric juice on cane sugar and starch….

The organic materials, pepsin and others, which the gastric juice contains are without action on the cane sugar. I add that they are incapable of saccharifying starch starch...

... Physiologically, it is the stomach glands that supply the hydrochloric acid necessary for pepsin to manifest its activity, in the normal gastric juice, on the albuminoid materials.

.... In a memoir on albuminoid materials, I demonstrated that these materials are complex amides and, like many amides and starchy compounds, they can contract combinations with acids...I showed that some of these substances could contain up to 14 percent hydrochloric acid which is not released by desiccation in a dry vacuum by quicklime; and these combinations resist even at temperatures of 100° and above.

...Now, the analysis of physiological gastric juice has allowed me to recognize, in addition to pepsin..., special albuminous substances which are equally capable of combining with hydrochloric acid; ....

.... So the gastric juice does not contain free hydrochloric acid, since this acid cannot be found in the presence of albuminoids without combining with them.

...

My intention is not to give you the history of digestion ...: suffice it to say that the zymase it contains, pepsin or gasterase, is accompanied by some other albuminoid substances: that this zymase and the other substances are incapable of interchanging cane sugar or of saccharifying starch; that pepsin alone is also impotent, all by itself, to digest insoluble substances, to modify those which are naturally soluble. For gasterase to act on albuminoid materials, it is necessary to have the presence of certain acids. This condition is physiologically fulfilled in the gastric juice,

which contains hydrochloric acid combined with either gastrase or with other albuminoid substances, or with both.
Now we can usefully begin the exposition of the experiments concerning the microzymas which accompany the gastric juice and those which I have at last learned to isolate from the glands proper of the stomach, we shall recognize that they sum up the properties of pepsin in the same way as the microzymas of the pancreas sum up those of the pancreatic juice and of pancreazymase. …..

## Properties of gastric mycrozymas

< succession of experiences p.317 à 323 >

...It is very remarkable, that during their stay, often prolonged beyond 24 hours, in the liquid resulting from the digestion of a given albuminoid material, **the gastric microzymas or those of the pepsigenic glands preserve their form without evolving into bacteria**.

And these microzymas do not exhaust their activity by a first digestion; they can be used again and again, either to digest the same albuminoid material or to digest another one.

...These are the facts; they are important in themselves, as much as because of the comparisons that establish a **functional specificity of stomach microzymas**.

# 7th conference

….

We have also explained how a double function can be observed in the organized ferments: a chemical function belonging to the zymase that the organized ferment secretes, and another function, chemical also by the generated products, but which is of physiological order if we consider it from a particular point of view...

…< reference to Liebig's doctrine of alteration p.332 >

Zymases are not the result of the alteration of an albuminoid substance, but of the normal and physiological function of a living organism. An organism generates soluble ferments in order to use them. Thus the yeast contains and forms ceaselessly, ..., the substance which I have called zymase... This is an albuminoid substance... It is not ... a product of decomposition; it is formed by the yeast for its own use, that is to say, for the physiological purpose of transforming the cane sugar into glucose which it can consume...

... In my opinion, brewer's yeast and other organized ferments are beings reduced to the state of a cell, in which phenomena of the same order are accomplished as in an animal that digests and feeds itself...

## Microzymas in human oral saliva

**...Human oral saliva possesses to a very high degree the power to saccharify amylaceous matter: it can be argued that no liquid of the organism can be compared to it in this respect.**

…< history > …

It is known that the oral saliva comes from several glands: parotid, submaxillary, sublingual, buccal-labial...the mixture of liquids secreted by these glands is called mixed saliva; it also contains the mucus proper to the mouth.

The mixed saliva is something very complex formed by soluble and insoluble materials.

….

*Preliminary experiments on the parotid saliva of dogs and horses*

…. There is a notable difference between the parotid saliva of the horse and that of the dog; the latter contains a zymase capable of transforming the insoluble starch of the starch into soluble starch.

….

*Comparative action of filtered human saliva, oral organisms and their wash water*

…. The oral microzymas and bacteria thus operate the saccharification of the starch in the same way as the saliva itself.

….< analysis of the transformation products (successively soluble starch, dextrins, glucose) - rotatory power p.352-353>…

**Oral microzymas, etc., therefore have the same function as the saliva that contains them.**

...The oral microzymas of dogs and horses are not functionally the same as those of the human mouth.

….

*Action of saliva and oral organisms on cane sugar*

…< experience p.358 >

It is therefore very remarkable..., to see organisms alone transform cane sugar so quickly and lose this property by their mixing with parotid saliva. This is explained by the fact that the oral organisms, feeding on parotid saliva, secrete a zymase which acts differently from the zymase they produce in the cane sugar solution.

....

The saliva of a clean mouth hardly contains anything but microzymas; there are undoubtedly **globules or cells of another form, but which are themselves carriers of microzymas and which by destroying themselves leave them free.**

## Functional variation of microzymas

...Now we have seen that the microzymas of the different organic centers do not all have the same way of acting on the starch. Those of the pancreas, for example, act very strongly to saccharify the starch; those of the liver limit themselves to fluidification, and it is the same for those of the thymus, of brewer's yeast or of almonds. We have also seen that the action on cane sugar is just as diverse. **All these facts should convince you that the germs in the air have nothing to do with the results**: if they were the cause of the phenomena observed, these phenomena, instead of varying with the origin of the microzyma, should be constantly identical.

...**Thus, it is a proven fact that the function of microzymas varies not only in the different organs of the same being; it also varies in the same organ of different beings and, ..., also with the age of that being**.

…< Experiments of different actions of different tissues of adults and embryos on starch >…

## Comparative action of zymases and organized ferments

… < p.367-371 >

## Composition of microzymas….

…< comparative table p.372>

... The comparison of ash <mineral matter> deserves some attention. That of the pancreas contains much iron...

... The great abundance of ash in the tonsil microzymas has struck me greatly...

... The relations of composition between these various organisms is of great simplicity and reminds one of the composition of albuminoid matter, and every living cell, animal or vegetable, has more or less the same composition, with the exception of certain utricles or vegetable fibers.

Wouldn't this analogy of composition explain the analogy of function?

…

## Spontaneous fermentation of the ostrich egg?

….

It is very singular that events have led me to study the function, as organized ferments, of the microzymas of the egg yolk. M. Donné, the scientist to whom micrography owes so many useful observations, did not share the opinions of M. Pasteur on the universal influence of atmospheric germs in determining alterations and putrefactions. And so that these germs could not be invoked, he tried to determine the putrefaction of eggs without opening them.

...

The ostrich egg, which Mr. Donné had brought to me on July 24, 1865, was in the state of a shaken egg; the white and the yolk were exactly mixed together; it was fermenting, that is to say, giving off gas.

.... The foamy matter, examined under the microscope by M. Donné, showed nothing foreign to the usual contents of eggs in these conditions: there were only microzymas. As for the reaction of this matter, it was frankly acidic...

The gases were released, by the abductor tube applied to the egg as to a fermentation apparatus, immediately I could collect ....

…< experimentation spread over several days p.378>

....What substance in the egg was used to form this alcohol and acids?

You know that the egg white and yolk contain sugar (glucose). Well! The sugar had disappeared, and even the most careful search could not find it...

.... As for the microzymas, they were found mixed with the fat and the lecithin retained on the filter.

....

We have in these experiments all the characteristics of the alcoholic fermentation and the butyric fermentation...

The egg microzymas have thus destroyed glucose in the same way as the brewer's yeast and the microzymas of chalk or the bacteria of butyric fermentation...

...

As for the microzymas ..., they remained without transformation....

The egg itself normally carries the cause of this fermentation and it is mainly in the yolk that this cause resides...

....

Ah! certainly the egg is organized, skilfully organized. And what precautions are taken so that nothing comes to disturb naturally the admirable order which reigns there. How many precautions are taken to isolate it from the accidents of outside. The shell, the membrane which lines it and which by its folds forms towards the end the air chamber. The yolk or vitellus is there as suspended by the chalazes in the white, formed itself of 2 concentric layers of unequal fluidity. In the yolk there is a reserved part, the cumulus proligere, the cicatricule, this white spot where the embryo will develop. The yolk itself, during its stay in the vesicle of Graaf, as it is protected before arriving in the oviduct, where it is at once enveloped by the albumen which is secreted by special glands.

The embryologists have admirably described all these parts ....

...But after having noted these marvelous arrangements, **have they looked for what is endowed with transforming activity in the egg, what is really alive, what weaves the cells, the tissues of the being which will come from it? And if they looked for it, did they recognize it?** While waiting for me to answer these questions, let's ask ourselves what happens when we scramble everything in the egg with strong shocks?

It happens that what in the divine plan constituted a premeditated arrangement, something structured, built for a certain purpose, has been destroyed; so that things which in the edifice were intended to remain separate, have been confused; what was acidic has been mixed with what was alkaline; subsequently the desired result is no longer achieved, although the necessary matter is still present! So what has changed? The conditions: apparently little, but in reality the essential, without which the material will remain sterile!

However, what was able to produce a chicken before, with its future, is it absolutely destroyed by the fact of having shaken the egg? No doubt it is a corpse of an egg, to speak like Mr. Donné; but in the chemical sense is it a corpse? No, since an activity is manifested. However, Mr. Donné and Mr. Pasteur refuse to see anything organized in it, and even more so nothing living!

....

Let us return to the function of the microzymas of the egg yolk.

.... Microzymas and yolk globules are the 2 essential anatomical elements of the egg yolk. But, as we shall see, the yolk globules are transient; the microzymas alone are permanent and never lacking....

< Demonstration of the action of microzymas on starch p.383 à 385>

< Fermentation of starch and sugar by isolated yolk microzymas p.386>…

Yolk microzymas are therefore alcohol and acetic acid producing ferments, as well when they act on the whole egg substance, but they are slow ferments. If, instead of leaving them to act for 5 or 6 months, we had stopped the experiment after a few days, the alcohol and acetic acid would not have been seen and we would have legitimately concluded that they do not possess the second function of organized ferments. You can see from this that one should not rush to conclusions. The second function can manifest itself very slowly.

And do not forget that thanks to creosote or phenic acid, we have the right to affirm that **the germs of the air are for nothing in the result of these experiments**, because by putting starch and sugar water in the same conditions, in the presence of pure albuminoid materials, free of microzymas, one obtains neither alcohol, nor acetic acid, however long the duration.

< other experiments of fermentation by oral organisms, liver microzymas, etc. p.389 à 396>

# 8th conference

….

The new work of M. Donné on eggs, concluded to the spontaneous generation of molds and animalcules in the egg material placed, it is true, in other conditions.

...

The matter of the egg according to Mr. Pasteur, is a natural substance that the life elaborates, endowed with virtues of transformation that the boiling destroys...

If the egg is nothing but that, there is nothing astonishing that Mr. Pasteur saw in a corpse only matter where there is nothing more living and which needs the germs of the air to putrefy!

.... You know what to think of this opinion because **you know that the liver, the muscle, the brain, the milk and the eggs, coming from living animals, or taken from the corpse, contain microzymas which do not die, but which, placed in new conditions, operate chemical transformations similar or identical to those they operated in the living being, either they evolve, within the tissues, to become bacteria, or they do not change.**

Mr. Pasteur studied the putrefaction of meat, but preoccupied with making his system of panspermia triumph, he explained everything by the germs of the air...

...; that according to him, if during life the body of animals is closed to the introduction of the germs of lower beings, it is not the same after death! Once again, you know where you stand: Mr. Pasteur did not see well; for having denied the existence of microzymas, he did not see the bacteria in the center of the pieces of meat he was examining.

...

In 1869, during the scientific congress of Montpellier, M. Estor and I made a communication in which the microzymas of higher organisms were considered even from the point of view of pathology. Here is the conclusion of this work:

"After death - here we leave the field of pathology to enter that of the physiology of the species - the matter must return to its primitive state, for it has been lent only for a time to the living organized being. In recent times, an excessive role has been given to the germs brought by the air; the air can indeed bring them, but they are not necessary. The microzymas in the state of bacteria are sufficient to ensure, through putrefaction, the circular movement of matter... The living being, filled with microzymas, thus carries within itself, the essential elements of life, disease, death and destruction. Gentlemen, let this diversity in the results not surprise us too much, the processes are the same; our cells, it is a fact of observation of all the moments, destroy themselves unceasingly, as a result of fermentations very similar to those which follow death; by entering the intimacy of the phenomena, one could really say, were it not for the shocking character of the expression, that we putrefy ourselves unceasingly."

...

It is important that you should become more and more convinced of the activity of microzymas in those parts of organisms which are removed from the life of the whole, and that the phenomena of fermentation are of those which characterize the regular life of the highest beings in organization.

...

The seed, during all the time of its germination, functions like an animal organism. A zymase is born in it, which digests the starch or the materials which take its place; ...I speak here only of the phenomenon of

digestion in the germinating seed. But the analogy with what happens in fermentations goes further...I was able to isolate enough alcohol to ignite it, by distilling barley that I had made germinate...

## The spontaneous fermentation of fruits

… I came to distill pears, apples and peaches ripened in the air and to note with certainty the presence of alcohol. But it is by studying what happens to the sorbs that hurt that I was able to demonstrate that **the phenomenon is really accomplished in the cells of the fruit**.

…<p.403 à 406>

… In short, Mr. Berard has established that the fruit separated from the tree is the seat of profound chemical transformations. This is a capital fact. It is certain that a fruit can be apparently unaltered, that nothing has penetrated it from the outside, and yet chemical transformations are accomplished. If Berard had distilled the fruits he had subjected to his various experiments, he would have found in them what I have discovered in milk, in urine, in scrambled eggs, that is, **alcohol** and **acetic acid**.

< experience hurt sorbs and medlars >

… The sorbs absorb oxygen and form no less alcohol; some of this oxygen is, no doubt, employed in the formation of carbonic acid, but much of this gas is evidently formed by the fruit itself, such as we have seen appear in the fermentation of eggs, and such as is produced in alcoholic fermentation in the complete shelter of oxygen. But you also see that alcohol and acetic acid are much more abundant in sorbs that have been placed in a limited atmosphere where carbonic acid accumulates.

< sorb and medlar wounding experience continued >

… You will not fail to observe that oxygen can intervene in the functioning of cells, **but as an auxiliary**; not as acting directly...

….< inconsistencies of Pasteur presenting his "new" ideas on fermentation, taken up by A. Béchamp but without going as far as admitting the presence of ferment in the organized being p.409 à 414>

….

... I was the first to highlight these two essential points, namely :

1. That organized and living ferments can be born in media devoid of albuminoid matter;

2. That the phenomena of fermentation by figured ferments, considered from the point of view that M. Dumas had formulated in 1844, are essentially phenomena of nutrition.

... **The cell is an aggregate of an infinite number of small beings**, having an independent life, a history of its own... We have seen the microzymas of animal cells associate 2 by 2, or in greater numbers, lengthen until they become bacteria or even bacteriids. We have seen very long bacteria (a kind of mycelium), a little wider, and, in the tubes they represented, granulations which were only waiting for a favorable environment to renew the series of observed phenomena.

...

... It is thus that the truth imposes itself. Mr. Pasteur, in order to write what we have been obliged to answer, has come a long way. He has been obliged to deny all his early work on putrefaction, since he comes to seek the origin of putrid gases, of putrefaction and gangrene, outside the germs of the air (he says "outside the organized ferments")

... You now know where the question stood in 1872: death, even for Mr. Pasteur, does not kill everything in an organism that ceases to live; fermentation phenomena can and necessarily do manifest themselves there.

... A remark about Mr. Pasteur's hypothesis, that an organized being, a cell, etc. act as ferments, produce alcohol when they are deprived of free oxygen. ... Remember that milk coming out of the mammary gland, brain and liver, taken from animals when they have just been sacrificed and still hot, sorbs, ripe apples, contain alcohol. All the tissues are charged with oxygen...Mr. Pasteur's hypothesis is belied by the facts.

...When Penicillum vegetates in the air, it is in the situation of any plant; when it is immersed in sugar, it produces alcohol, because the microzymas change their function.

... The second error is to believe that the cells are the agents that, after death, produce the phenomenon of fermentation, as you can see for yourselves, since you know that animal cells perish very quickly and disappear, leaving no other trace of their existence than the microzymas... I will show you later on what is the mechanism of the destruction of the cells and the physiological release of the microzymas. And finally, remember that isolated microzymas, which have become free in a tissue after death, can evolve to produce bacteria, and that artificially isolated, they can act on starch to produce alcohol and acetic acid.

...And now you will easily understand that the *transforming virtues that boiling destroys*, as Mr. Pasteur expressed them, are none other than the microzymas. In any organism, the microzymas alone are endowed with a life of their own in the chemical sense; it is in them that the virtue of transformation resides, and many other virtues that Mr. Pasteur does not yet suspect: their perenniality for example.

## Effect of temperature on microzymas

And *these transforming virtues*, this chemical activity is not annihilated, for all microzymas at the same temperature. While air microzymas lose, not only their chemical activity, but their ability to produce bacteria after a few minutes of boiling, in neutral, slightly alkaline or slightly acidic solutions, there are microzymas that lose it only after several hours of boiling or by a temperature higher than 100° ... it may depend on the circumstances and the particular conditions where these microzymas are placed. Finally, there are very inferior organisms that resist to a temperature close to boiling, others to a much lower temperature: brewer's yeast is entirely inactive before 60°.

....< p.418 > ...

## Function of the glands

.... Let's go back to microzymas ...and show by 2 topical examples, that they act by themselves in the cells of the glands that contain them.

### The pancreas

This gland contains a highly developed vascular network which brings blood to it and a network of capillary collecting ducts, which lead to large ducts where the products elaborated by the gland are collected to be poured into the intestine. The glandular vesicles contain the cells specific to the pancreas, all of which are immersed in a mass of connective tissue. Such is the constitution of the gland and you will have a clear idea if you add that the cells are more or less abundantly provided with microzymas. It is in this apparatus that the pancreatic juice is produced to be poured into the duodenum.

Notice first that the gland receives nothing but blood. Now, the blood, Cl Bernard has already remarked, does not contain the active principle of the pancreas.

...Or, independently of the zymases, the pancreatic juice contains several crystallizable compounds: leucine, tyrosine, xanthine, hypoxanthine or sarcine and other products that are not well known or that vary according to the nature of the animal.

Having said this, note that pancreatic microzymas possess the property of fluidizing and saccharifying starch starch, like pancreatic juice; of dissolving and deeply transforming albuminoid materials with as much energy as pancreatic juice itself and pancreazymase. But, in addition, these microzymas, which do not contain leucine, tyrosine, etc., produce them together with other crystallizable compounds in their action on these albuminoid materials.

I have found that when the tissue of the pancreas has been carefully crushed and washed free of all microzymas, this tissue, although absolutely unaltered chemically, no longer acts on the starch starch. In short, all the activity of the gland tissue is concentrated in the microzymas.

....< suite p.420 – 422 >...

It is only after the second month of birth that the liquefying action on the starch begins to manifest itself. Unfortunately, there is still no information about the time when the pancreatic microzymas act on the albuminoid material.

The function of the pancreas, as seen in the adult, is therefore established only gradually, and the proper activity of the microzymas in the gland, as in the other organic centers, is the result of a kind of maturation, of functional evolution which testifies to the spontaneity of the organism at the same time as to the change in function of its fundamental histological elements: the microzymas...

## The stomach: secretion of gastric juice

... If the structure of the pancreas is already quite remarkable, it is quite different for the stomach glands. These glands are surrounded by an abundant capillary network and filled with a large quantity of cells, which, on an empty stomach, are pale and transparent, while the tubes or glandular sacs which contain them are collapsed and shriveled. Some time after the meal, on the contrary, the cells are swollen, increased in volume, and their contents are clouded by fine granulations. At the end of digestion, all the cells decrease in volume again, but are still granular...

... Let's see what happens when the food arrives in the stomach.

On an empty stomach, the entire stomach mucosa is pale and covered with a sticky coating, with a weakly acid, neutral or even alkaline reaction, secreted by the glands.

As soon as food passes the stomach, or the mucous membrane is excited by chemical agents, the circulation becomes very active; the blood flowing into the capillary network of the mucous membrane, the veins dilate, the blood they contain takes on a lighter hue, the whole surface of the organ takes on a pinkish hue, and the gastric juice flows through the glandular orifices.

....< comparison of gastric juices with blood, the influx of which determines the functioning of the glandular cells p.423 – 424 >...

The gastric juice, variable in the amount of organic matter and salts it contains, is constantly energetically acidic in reaction,... it contains high proportions of sodium, potassium, calcium and ammonium chloride, with a small amount of phosphate of lime, magnesia and iron. The amount of organic matter in the gastric juice is always very small. I have never found more than 2% and usually less in dog gastric juice. The gastric juice of sheep and humans contains even less.

The acidity of gastric juice is thought to be due to free hydrochloric acid. My own research has led me to a different opinion. **There is no free hydrochloric acid in the gastric juice, but a hydrochloride of albuminoid matter.**

...< gastric juice analysis after administration of a bone fragment to a dog p.425 >...

...But we can conclude, considering the activity of the isolated gastric microzymas, that they are the ones who, in the cells, act on the ambient materials, in order to produce, with the help of these materials, not only the gastric zymase but also the hydrochloric acid which remains united to the albuminoid matter of the gastric juice.

...< fonction des glandes et des tissus en général p. 426 à 429 >...

> All these facts lead to believe, as to a demonstration, that each tissue as well as each gland, each special cell, are so many centers of transforming activities which act unceasingly on the environment within which they are plunged, while they themselves undergo interior modifications, of a chemical order and physiological order. And this remark brings me back to the **particular study of the microzymas considered as the cause of the mentioned transformations and then as builders of the cells and tissues.**
>
> Up to now I have considered microzymas from 3 points of view:
>
> - they are generators of bacteria by evolution ;
> - they have a chemical function through the zymase that they can secrete
> - and a nutritional function by virtue of which they operate profound transformations of the fermentable matter from which alcohol, acetic acid and, in certain circumstances, lactic acid, butyric acid and other more or less numerous products are produced. This alcohol, these acids, etc., are said to be products of fermentation: in reality, they are products of de-assimilation....

## Microzymas as cell factors

They have a fourth: a physiological function of a much higher order. **They are factors of cells and, from one to another, they are responsible for building the organized being that we call an animal or a vegetable**.

The difficulty of demonstrating this point of their history is much greater than when it is a question of establishing their other functions ....

...fortunately, there are organisms, possessing all the attributes of organization and life, which are reduced to the state of cells, thanks to them it is possible to proceed to fruitful observations on the mechanism of the construction of the cells in the raised organisms...

...< cellulogenesis by the microzymas of the Vinegar Mother → p. 430 à 435 >...

...< Vinegar mother and bacteria. → p. 441 >...

...< Molitg glairine regresses cells into microzymas. → p. 445 >...

...< Yeast cell regression in microzymas. → p. 453 >...

...< Mechanical destruction of the yeast. .... → p. 454 >...

# 9th conference

## Origin of the cell

Nothing is more controversial among physiologists than the origin of the organized cell.

…< p.464 – 465 >…

I profess the opinion that it is an error to believe that there can exist living substances, protoplasma or blastema, anhistory, not morphologically defined. All the experiments of these lectures prove that there is life only in a substance complex by its chemical composition and structured: **the microzyma is the last histological element of any living form**! But is it true that a cell always proceeds from another cell? Is there not another mode of cellular genesis?

It is of great interest to answer these 2 questions and to have an exact idea of what we should understand by these words: living matter!

We have seen that a cell can be produced without the help of another cell.

The examples of those formed by the microzymas of the mother of vinegar, by those of the glairine of Molitg and of the crushed yeast, are of the simplest, but refer only to beings which live under the preserved cellular form. Here are equally simple examples of the formation of a higher order animal cell.

## Formation of leukocytes.

…< experiments of leukocyte genesis by M.Onimus; bladders, parchment, bladder… filled with different liquids and slipped under the skin of animals …p.467 à 469 >

Mr. Onimus has not paid attention to the molecular granulations; like everyone else, he believes them to be without any physiological and histological activity. There is no spontaneous generation of leukocytes, which are real cells, but the meeting of conditions where microzymas, as in the experiments on the Vinegar Mother, are able to come together to form cells; and the proof that this is so is that when these conditions are not all met, the microzymas evolve to produce vibrios or bacteria

...In short, leukocytes appear only in those circumstances where microzymas have been found in the conditions where they form leukocytes in the organism.

...Secondly, the microzymas, in certain liquids endowed with viscosity, pass through the tightest filters and membranes like the bladder and the swim bladder. In the experiments of M. Onimus, the microzymas of the liquids of the wound pass with the liquids in the ampoule; you will conceive it all the more easily, if the fact of the birth of bacteria were not enough for you, by noticing, that there are microzymas so small that they are visible only with the aid of the immersion objectives of Nachet; so small that it is necessary to know how to look for them in order to find them.

... In cases where the author did not see leukocytes or bacteria, he does not tell us that there were no molecular granulations...

...In short, the facts observed by Mr. Ominus have their explanation in those I have made known to you about the Vinegar Mother...

Thus, the microzymas of the Vinegar Mother, those of the animal tissues in the experiments of Mr. Onimus, according to the media, sometimes do not change, sometimes give bacteria, sometimes cells.

….

## Mechanism of the generation of bacteria ….

...I have limited myself to what patient observation has revealed to me as positive in the experimentation reduced to its simplest terms.

... Let us see how in the vinegar mother the bacterium proceeds from the microzyma; we will then see how the cell is born. In the circumstances in which we see the birth of bacteria, here is what we notice: this little organism does not appear all of a piece...; no, but the microzymas that were isolated actually proliferate; then we see some that are as if clumped together in 2, in 8 of a number, then in straight strings, of three, of four and more grains...; then the grains of the strings of the microzymas seem to lengthen, **the bacteria itself appears as the fusion, as it were, of all these grains that we have compared to a stick**. <Planche 1 at the end of the book fig.1, 2, 3 - explanations page suivante>. At the same time as these transformations take place, the membrane disintegrates, ..., and its tissue soon appears to be formed only of bacteria.

## Cell formation

< Planche 1 fg 5 after the table of contents p.993 >

Let's see what happens when the conditions are such that cells are formed.

...The Vinegar Mother is membranous ...the microzymas are joined together by a unifying, hyaline material. As the cells appear, things happen as if the microzymas consumed at the same time both the food supplied to them by the sweet broth and the hyaline matter which unites them, and, agglomerating, secreted the matter which forms the envelope, the walls of the cell. In fact, while the cells are being formed, the fermentation movement, which produces the alcohol, begins. The fact is that the cells are not born in the whole mass of the vinegar mother at once, but first on the surface and then gradually in the depth, so that in the end we have a thin membrane formed by an agglomeration of loosely joined cells, which can be easily detached by the slightest rubbing. And if one observes carefully, one sees microzymas on the edges of the flaps, separated microzymas, released from the membrane, which are reunited, and cells are born in the surrounding medium, by the same mechanism.

And it is necessary to note the independence of the 2 phenomena: **the appearance of the bacteria excludes the formation of the cells themselves, and vice versa**... It is also what Mr. Onimus saw: when the leukocytes are formed, he does not note vibrionians, and when these appear, there are no leukocytes.

…< clarification of an attack by Pasteur and inconsistency of his experimental conclusions, Pasteur confuses the so-called Mycoderma aceti (which does not contain microzymas) with the Vinegar Mother p.473 à 477 >…

## Polymorphism

Polymorphism is the quality of a being or a body that presents itself to us in several forms or states. Phosphorus, sulfur, are simple polymorphic bodies. A given animal species has its own normal polymorphism which can manifest itself in several ways. The tadpole and the frog are the same species; the caterpillar, the chrysalis, and the butterfly are various forms of a lepidoptera. The normal microzyma of a given tissue, of a given cell, is, likewise, like an earlier state of the bacterium, and it becomes this completed form by passing through the intermediate forms I have shown you. ...

...the yeast does not become bacterium; a cell neither; but by destroying itself the cell puts its microzymas in freedom and only then they can become vibrionian if the conditions allow it…

…

## Role of the cell envelope

... the cell is a closed space enclosing a content that can itself be organized.

The envelope of the cell is a membrane that is essentially insoluble in the medium in which the cell is intended to live and function. Most often, because of the insolubility of the envelope, the cell is also insoluble in water, so that, more often than not, it is possible to observe it outside the medium from which it has been separated.

I said to you that the dimensions of the cells were of microscopic order: they have always less than 1 mm of diameter, there are some which have less than 1/100 mm, there are some which hardly reach the 1/1000 mm....

... Most of the time, the still young cells appear under the microscope as a homogeneous mass in which nothing figurative can be distinguished. But in almost all of them, there comes a time when it is easy to distinguish a fine granular content which has been noted by all observers. Does this prove that these cells are devoid of microzymas? No, this is simply an optical phenomenon; if the refractive power of the microzymas contained is approximately the same as that of the substance in which they are immersed in the cell, they will not be observable; this is how the lens, which is only formed of tubes and figurative elements, is absolutely transparent. - Generally, when a cell has a nucleus and no granulations are visible, **it is in the nucleus that the granulations first appear**. But when the nucleus itself is not seen, there comes a moment when, in the cell, a work is done which makes a nucleus appear, and it is in what can be considered as such that the granulations are first seen, and then the nucleus becomes granular: whatever form the cell takes, whatever deformations or expansions emanate from it, this is what we will always see.

In the experiments that I have quoted on yeast put in the poison or subjected to autophagy, if it is young, if the contents are homogeneous, this appearance is exaggerated at first, then the contents contract, and one distinguishes clearly the limited and distinct contents of the envelope: a little later, this mass becomes granular, and one can see the granulations moving in it and overtaking the outline; finally all the interior becomes granular, and the granulations gather together and fall against the walls of the cell. This is what happens to every kind of cell in the process of regression; finally the cell itself vanishes, and only the molecular granulations remain of it as figurative objects. And this is not the fruit of my personal observations only, it is that of all observers.

…< comparative fermentation experiment, intact yeast (alcoholic fermentation) and crushed yeast (lactic fermentation) ...

... then other experiments of endosmosis and diffusion p. 481 à 485 > …

...The limiting membrane of the cell can thus let penetrate, by osmotic diffusion, into the cell cavity, certain substances destined to be transformed there for the needs of the cell; reciprocally, the same membrane lets out of its cell cavity, by an inverse osmotic action, the materials which have been transformed there. Through the cell membrane, while the cell is functioning, there must be a double current, from outside to inside, and another from inside to outside. It is difficult to observe this double current directly, but it is easy to realize it by observing carefully what happens to the brewer's yeast during the alcoholic fermentation of sugar cane.

For the materials which compose the liquid medium which surrounds the cell to penetrate it, they must first possess the necessary diffusibility, and we know that it is not enough for a substance to be soluble to be diffusible through all the membranes.

Cane sugar, although very soluble, does not undergo alcoholic fermentation directly. As soon as we put yeast in the solution of this body, as I proved to you, the zythozymase comes out of the yeast by osmotic diffusion and will transform the cane sugar into glucose or invert sugar. Then the alcoholic fermentation starts, because the glucose can enter the cell, the cavity of each yeast cell, and is transformed there.

In short, the yeast, in order to feed on cane sugar, first converts it into glucose. And when, after this digestion (this is a digestion in the same way as the digestion of starch by saliva) the glucose formed has diffused into the cell cavity, that it has been assimilated, that it has become a momentary integral part of the yeast, that in this new state it has been decomposed, then the products of its decomposition diffuse in the opposite direction into the surrounding environment, together with some of the cell's own and transformed materials : and it is in this that the de-assimilation which follows absorption and assimilation consists. The de-assimilated products, it is conceivable, do not enter the cell, and it is thus that the constancy of the phenomenon and the harmony of the function are preserved. This is, in my opinion, the role of the enveloping membrane of the cell; it puts the microzymas in constant conditions of environment: **the conditions do not vary**, they do not change either in form or in function.

And this applies to free cells of a specificity, as is the brewer's yeast, as well as to cells that can only live and function in the place where they are born, in the complex organism that constitutes an animal or a plant...

... And now you understand how it happens that the brewer's yeast cell is destroyed in the starch. It is because the microzymas are placed in an abnormal situation: since nothing can penetrate the cell, since no glucose can be formed, and neither dextrin nor starch are osmotic for its membrane, they <the microzymas> transform the very contents of the globules; the globules are thus gradually resorbed, and everything is resolved into soluble products and microzymas which become free. And this is what happens in the organism itself, when after death, the cells are in a state of starvation; they are devoured by their microzymas to which the circulation no longer brings anything to transform.

But independently of their chemical role ..., the cells play a purely histological role: they serve from one to another, and in each organic center, to constitute the tissues where they are joined together by a unifying intercellular substance. **The genesis of cells in the organism is incessant as well as their destruction**; we will draw the conclusion that it is for this reason that in the normal physiological state, microzymas are not very abundant in the liquids of the organism.

## Genesis of cells in higher organisms

### Constitution and formation of the egg

…< egg seen by Milne Edwards p.488-489 >…

... The cell which will be the egg is, from the beginning, isolated, possessing its individuality. In all the strength of the term, the egg is the fruit of a new formation, I would say a creation if we did not know the agents that build it.

I have tried to understand the formation of the primordial ovum; before explaining it to you, we must know more exactly the constitution of the egg when it has reached maturity, that is to say, when it is ready for the evolution which successively produces the embryo and the new complete being. I have studied more especially the egg of birds. **The part of this egg which corresponds to the mammalian egg is the yolk, the vitellus.**

... It is important that you have an exact knowledge of the anatomical constitution of the yolk of the hen's egg... a central cavity (latebra) is found hollowed out of the mass, containing a material which is lighter than the rest; it is provided with a canal which communicates with the germinal vesicle and the cutricle. There is thus a certain anatomical structure in the yolk. The cavity of the latebra contains, like a hiding-place, a matter which undoubtedly possesses a different composition from that of the yolk which surrounds it, for in the egg hardened by heat, it is the matter of the latebra which coagulates last. But the cells or vitelline globules which we discover there are of the same appearance as those of the yolk...

... To see them, it is only necessary to use a weak magnification. But to distinguish clearly all the particularities which I observed, it is necessary to use the combination objective 5 oc. 1 of Nachet and sometimes the objective 7. It is also necessary not to dilute the matter of the yellow in a too great quantity of water, and it is better to observe it directly in very thin layer.

I have looked for the yolk globules in the yolk, still contained in the ovary of a hen, at the various periods of its development, while it is still contained in the stroma of the ovary which it makes bumpy, and when, having become more voluminous, the calyx is clearly detached and suspended from the ovary by its stalk. The ovule being detached is washed under a net of water, wiped on blotting paper, and broken on the object holder to collect all the contents, if it is small enough.

Here is what I have observed on a series of ovules, from when they are one mm in diameter, until they reach more than 3 cm:

…< observations p.492 – 493 and representation planche II at the end of the book >…

... When the ovum has not yet reached 2 cm in diameter, it is possible to discover states of this ovum where there are only molecular granulations; these are the extremes. When the microzymas decrease, the yolk globules increase and vice versa: this is the middle state. What is the significance of these facts? This is what must be examined in the light of the experiments which led me to affirm that the microzymas are cell factors in certain favorable circumstances.

…

## Yolk microzymas

Let us first posit, as absolute evidence, that there is a greater abundance of matter in a 30 mm yolk than in a 1 mm yolk, and as, in both circumstances, a catch of the matter it contains appears under the microscope as uniformly granular. It must be concluded that the microzymas, or, if you like, the molecular granulations, have increased proportionally. Now, from the beginning, it is often impossible to discover anything else than microzymas; on the other hand, as the vessels which feed the ovary, blood and lymphatic vessels, do not penetrate into the ovum and do not go beyond the capsule which forms the vesicle of Graaf, it is clear that nothing figurative penetrates through the vitelline membrane into the cavity of the vitellus; only what is sufficiently osmotic can penetrate there; the histological elements cannot therefore multiply except by the mechanism which I have tried to discover, using the nutrition materials which penetrate there by endosmosis. The microzymas of the yolk of the hen's egg, I have shown you, are organized; they are alive; they contain several species of albuminoid matter, one of which is evidently a zymase; their elementary composition is not the same in the ovum taken from the ovary and in the yolk of the completed egg; while they are multiplying, they evidently act, in order to assimilate it, on the unorganized nutritive matter which endosmosis brings to them. But where does this multiplication take place? They do not multiply, while they are free since in the ovules of the same dimension one can find, in some, only isolated granulations, in others vitelline globules all alone, without surrounding granulations; then in more voluminous cells, again, nothing but microzymas, and then nothing but globules, and so on until the vitellus has become relatively voluminous! In short, the experiment shows that **there is an alternative formation and destruction of yolk globules**. Since these globules form and then disappear, it is undoubtedly because they are not essential to the evolution of the future embryo. They must however have a purpose! What is it?

**It is here that the theory of cell formation by microzymas finds its first application to the development of the animal organism and to organisms in general.**

**... there is no spontaneous generation, because nothing is made without anything. The conclusion is forced: it is the living microzymas of the yolk that make the cells,** ...

But what is the purpose of this formation of cells? As I explained earlier, it is to place the microzymas themselves in a medium that does not vary. In other words, the microzymas imprison themselves to

mature. In fact, a considerable amount of work is done in these cells, made manifest by the changes that we have observed. They grow, and a nucleus appears; this nucleus divides and the cell ends up containing several of them, and these nuclei become granular, and then the whole cell becomes granular in its turn. It may also happen that, the nuclei having grown, the cell resorbs to set them free, and we can see as in fig. 2, one of these nuclei dividing, one half being already granular and the other becoming so; finally, all the cells of the yolk having completed their career, they resorb, and the whole yolk contains only microzymas and oily globules.... < observations of Schwann and Reichert p.496 – 497 > ...

... I have noted other particularities which prove that even when the globules in question are homogeneous, that is to say, when they appear to be of a uniform texture, without interior granulations, these granulations exist nonetheless, but endowed with the same refractive power as the medium in which they are immersed, one does not see them.

One of the means of studying vitelline globules consists in the use of Muller's liquid (solution of potassium dichromate and sodium sulfate in water). Thus the homogeneous vitelline globules of the drawings concerning the ovules still contained in the calyx, become mostly granular when this liquid is added to the preparation; the nuclei which were not visible are then seen if there are any; generally the globules become much larger, they sometimes double in volume, break, and one sees the granulations escaping like a cloud.

...< p.498 >...

Only one thing seems constant, it is that the latebra always contains vitelline globules until the moment when the phenomena of incubation begin which give birth to the embryo...

... In the yolk of the egg, one discovers... , almost never cells with nuclei, neither in the mass of the vitellus nor in the latebra; but we have seen that they are constantly observed, at a given moment in the ovule. Finally, I have never seen this nucleus appear either, by means of Muller's liquid, in the globules of the vitellus which have reached maturity in the complete egg.

It seemed to me that the yolk with its microzymas was an admirably arranged apparatus to verify, directly, the consequences which followed from the experiments on the formation of cells by the microzymas.

... < it should be noted that more than one hundred chicken egg yolks were examined at various times p.499 > ...

I have already spoken of the impenetrability of the vitelline membrane to external germs, even to bacteria and vibrios, and also of the difficulty with which vitelline microzymas evolve to give bacteria. Before showing you these same microzymas as cell factors, let me, as a last verification of this fact, report to you yet another experiment of the same kind which will show you at the same time that in certain media the vitelline globules can be preserved intact.

... < experiences p.499 à 505 > ...

These experiments were repeated: It is a general fact that the yolk of the egg put in sugar water is preserved without apparent alteration, and that the yolk globules multiply there while becoming more voluminous...

...

And now there are several consequences to be drawn from these various experiments.

1. Yolk microzymas do not easily evolve into bacteria, either outside the yolk or within the yolk itself.
2. Alcohol and acetic acid are the constant products of the stay of the egg, or the yolk, or the isolated microzymas in sugar water...
3. Yolk globules are preserved indefinitely in a suitably concentrated sugar solution.
4. Yolk globules are formed in the sugar medium, so the microzymas can disappear completely in the yolk.

5. In the sugar medium the globules formed do not regress, probably because under the conditions of the experiment the medium does not change fast enough.
6. The yolk globules are not identical in the eggs of different birds.
7. The mechanism of formation of these globules is the same, physiologically in the egg and in the egg; extra-physiologically in the egg, or in the isolated yolk which is placed in sugar water.
8. It is probable that it is in the vitelline globule that the microzymas operate the chemical transformations of the materials which the circulation brings to the ovum; transformations which result in the production of lecithin, of the fatty bodies, of the albuminoids proper to the vitellus which do not exist in the blood; of the coloring matters and of the glucose, materials some of which serve for the multiplication of the microzymas themselves in the cells which grow. Hence the more general consequence, that the vitelline globules fill in the ovum, during its development, the same role as the cells in the glands and in the other tissues.

…

Thus I firmly believe that it is demonstrated, on the one hand, that vitelline microzymas are the factors of vitelline globules and, on the other hand, that these microzymas multiply, mature in this globule and become free again by its destruction...

...

Here is the hen's egg constituted; what will become of the organized elements that we have observed there, when the egg is incubated either by the hen or in an artificial incubator? Mr. Estor and I have researched this in a work that goes back to 1870 and that we published in 1872.

## Microzymas during embryonic development

After recalling the facts of cellulogenesis with which you are familiar, we announce that we propose to examine the role of microzymas during the development of tissues, and we demonstrate their presence in all anatomical elements during the first periods of the embryonic life of the chicken.

You will remember that at one time only microzymas are found in the yolk, as figurative elements, and that these microzymas disappear or are dissolved under the influence of acetic acid and potash to the tenth in aqueous solution. There is some change in this respect during incubation; the microzymas which are not in the sphere of development of the embryo still disappear by acetic acid and by potash; but in the embryo they are generally resistant to acetic acid, and, at one time, in some centers, also to potash. During the whole embryonic period, according to the experiments I have reported, we should be able to follow them during the development of each tissue. And, indeed, we have seen them and followed them in the connective tissue, the blood corpuscles, the muscles, the nerve centers, the glands, etc.

… < observations at different stages of development p. 508 à 512 >…

...And there is no need to hesitate, because in all this work we find the microzymas behaving as we have seen them behave in the vitellus to form the vitelline globules, in the sweet yeast broth when those of the crushed yeast or those of the Mother of vinegar generate the cells of the alcoholic ferment! They come together, pack themselves in the form of a sphere and, thus united, they secrete an envelope, and the cell is constituted! I repeat, this is the immediate result of observation, not the result of a preconceived system. **Microzymas are cell factors**; and they are also capable of producing vibrionians!

...

My task would be finished here, since I have led you, starting from the study of atmospheric microzyma and chalk, to that of the microzymas of plants and animals which I have shown you evolving into bacteria and accomplishing their highest function, which is to constitute the tissues of the bird, and subsequently of

every animal and of man! But it is necessary to insist, in order to make you see that the new theory of cellulogenesis agrees with a certain number of previous observations which they explain, and in order to warn you against what some people may tell you that this theory is not new.

Anatomy reveals us...

...Pushing further the anatomical analysis, Bichat distinguished, in these organized systems, simpler parts, which he considered as the elements of the organization: these elements are 21 in number in his classification. The impulse given to the scientific movement by Bichat was immense. It is from him that the truly scientific history of tissues dates. But there is something simpler in Bichat's tissue, which the microscope alone has made it possible to discover, it is the cellular element, what has been called the element of formation, the last organic unit, beyond which there would be nothing more organized. You know that we stopped too early...

It is not however, as you know, that histologists have not seen the microzymas; under the name of molecular granulations, they have described and drawn them in the tissues, in and around the cells. They have even been made to play a role in cellulogenesis, but a purely mechanical role, not as endowed with life and organized.

Nothing is stranger than the attempts made to explain the birth of the cell. ...

...< overview of theories p.514 à 519 >...

...< Experiment: observation of dead fetus p. 519 à 520 >...

It has been said that the vital action should not, in the last analysis, be rejected beyond the cell: this was to pronounce prematurely. **The cell is not the permanent histogenic element**: its existence being transitory, it cannot be considered the vital unit. Beyond the cell, there is the microzyma; this one forms the cell, and it remains when it is destroyed. The microzyma is immanent when compared to the cell; it is the support of the vital action, of life; it is the primordial organized element.

# 10th conference

The considerations with which I ended the preceding lecture were like the summary of the doctrine which I have been expounding since the beginning... It is necessary to insist more, in order to penetrate you well of the truth which so many facts bring out, namely: that **the microzyma is the only permanent anatomical element of the organism**, the one in which is concentrated all the physiological and chemical activity, and, to say it all in a word, the vital activity of this organism. And, if this is so, I can pose the following postulate, which so many demonstrated theorems make legitimate, namely:

**Microzymas are at the beginning and at the end of any organization. They are what makes an organism, a cell, a tissue, alive. Even more generally: any organism is reducible to the microzyma**.

In order to make this postulate admitted as necessary and demonstrated, and to be able to deduce from it all the consequences, not only those which have to do with general and particular physiology, but above all with pathology, it is necessary to fight the prejudices which two famous theories have penetrated into people's minds: the cellular theory and the theory of the blastemas and protoplasmas, which are at present in a position to answer the two questions which follow:

"What is, for a living being, to be organized?

"What is living matter?....

## The cellular theory and its insufficiency.

...According to Küss and M. Virchow, the cell is "the organic element per se (in itself)" "the vital action emanates from this element". The cell "is the final morphological element of all vital phenomena; and vital action must not, in the last analysis, be rejected beyond the cell... The living element is active only so long as it presents itself to us as a complete whole, enjoying a particular existence."

...In pathology, he says < R. Virchow >, we can lay down this great law: There is no new creation, it does not exist any more for complete organisms than for particular elements.... Similarly in physiological and pathological histology, we deny the possibility of the formation of a cell by a non-cellular substance. The cell presupposes the existence of a cell (omnis cellula a cellula),...

... Yes, affirm with Mr. Virchow that spontaneous generation is a chimera and that all that is organized proceeds from what is already organized. Only, we are going to investigate if the cell is indeed the primordial organized element and if the vital action emanates only from the cell....

...< Virchow's theory suite p.524 – 529 >...

On the one hand, the cell is represented by the membrane and the nucleus; but this nucleus and this membrane are, according to Virchow, not endowed with any activity, and the properties of such cells are related to those of the contents, which are variable. On the other hand, it is difficult to understand how the cell can owe any of its properties to the substance outside it. However, this nucleus, which is supposed to be devoid of activity, would nevertheless be the starting point of the alterations which occur in the cell. Moreover, Virchow recognizes that there are transient cells, those which can lose their nucleus! It is difficult to understand how an autonomous element can be transient, and how the nucleus, which is one of the characteristics without which the cell does not exist, can be lost. And there are other cells which are as transient as the blood cell: I have shown you this. The whole book of Mr. Virchow is there to show us how much the cell can vary, and we can deal with treatises of histology which have a chapter devoted to the destruction of the cell. And I do not intend to give here the whole history of the vicissitudes of the cellular theory: cells without envelope formed only by a nucleus surrounded by a protoplasm; cells represented only by the nucleus, etc.

The cell is therefore not the essential anatomical element, primitive of tissues, which physiology and chemistry need equally, and the omnis cellula a cellula is not the statement of an experimental truth; **it is a hypothesis which has not been verified to its full extent**.

…< Schwann system: Blastatic formation of the cell p. 531 > …

## Organic atoms

**Henle** had protested against Schwann's system, according to which the cell is the result of crystallization; and to convince you that **Henle regarded the granulations as organized**, I will read you his refutation of Schwann:

"...Things happen in quite another way in many cases: the nucleus develops at the expense of the granulations, the latter become confused or fluidized, and the operation is thus precisely the reverse of that which takes place in crystallization, in which dissolved bodies pass into the solid state. If one were now to admit that the cell and the nucleus are secondary forms, and if one were to consider the elementary granulations as organic crystals, one would have to object that these granulations themselves are already composed of two substances united, not chemically, but only in a mechanical way, the albuminous envelope and the included fat droplet. The analogy between cells and crystals is thus reduced to the fact that both are bodies of a determined figure, which are deposited from a liquid; ..."

...

"We have arrived at this result," he says, "that the organism is composed of a certain number of elementary parts, monads or organic atoms, which, dominated and held together by a power subtracted from our means of investigation, arrange and develop themselves in accordance with a type...These monads are endowed with particular forces, for it is sufficient to have a common source, the yolk or blood, to form and nourish all the cells, each according to its kind. < p.533 réf(1) >. » …

"General anatomy, in order to be the science of the effective elementary parts of the body, should therefore today start from these monads, begin by studying their structure, formation, forces, chemical and physical properties, and then give rise to the tissues, which are nothing other than aggregates of a multitude of homogeneous elementary particles."

Certainly the organic atoms of Henle are nothing other than the molecular granulations of the authors...

…< the cell according to Küss p. 534 – 535 > …

… But Küss, while being one of the creators of the cell theory, ..., taught us that it is a transitory organism, constantly forming and destroying itself, **without explaining otherwise the cause of its destruction**.

...Küss never spoke to us about the theory of blastema except to fight it; he did not want to hear about the mechanical theories of cellulogenesis. In short, Küss must be considered as the precursor of M. Virchow; it is from his doctrine that I was nourished during the whole course of my medical studies.

## The cell and microzymas

I was therefore ill-prepared for the construction of a different theory, to discover the primitive organized element, the one from which the cell proceeds. So it is little by little, by deduction, that the new doctrine that I continue to develop before you has developed. It is not necessary, however, that everything is inaccurate in the cellular theory**. I do not dispute the considerable role of the cell, but I say that this role is secondary; the cell is only by the microzyma, is only governed by the microzyma**. But from the fact that the microzyma forms the cell, primitively, it does not follow that this one cannot reproduce itself.

**Certainly a cell can come from another cell, it is a fact**; moreover, the cell alone can constitute an organism; there are beings which are reduced to the cell and which live and reproduce in the unicellular state. When I spoke to you about transitional cells according to Küss, I was referring to those that function in higher organisms, of which they are necessary secondary elements; necessary both as structural elements and as apparatuses with a double function: chemical and physiological. These kinds of cells can only develop, live, function regularly, in the place and the environment which sees them being born or transformed; some of them, when the function is accomplished, destroy themselves and disappear without return: they do not reproduce; the ovum, the spermatic cell for example, or the spermatozoids which are born there: we will come back to these particularities later.

Brewer's yeast and other analogues are unicellular organisms. How different they are from the cells of higher beings, plants or animals!

Brewer's yeast is a living cell which, in the fermentable medium capable of supplying it with all the elements of nutrition it needs, can organize others which, having become independent, in their turn, become the mothers of a numerous filiation. However, morphologically, yeast cells do not differ essentially from the cells found in more complicated organisms. And is it not noteworthy that in multiplying in this way they retain, along with the form, the function of the mother cell? There are protozoa which are in the same case: special authors have described the various modes of multiplication. The superior organisms contain cells which can reproduce themselves according to one or the other of these modes. There are thus organized beings whose structure is very simple and which live without vessels and without nervous system.

Some animal tissues, even those of the highest organization, have neither capillaries nor nerves, and over great distances they have no cells; these tissues are in some way isolated in the organism of which they are a part, and are united to neighboring tissues only by contiguity: they are alive, however! What is the organized element capable of preserving for them their faculty of living?

But all the cells of the organism and each one in particular, in each center of organization, have their individuality, their existence and their distinct and proper functioning; none of them communicates directly either with the capillaries of the vascular system, or with the nerves. In short, each one has its own autonomy: the hematite in the blood, the hepatic cell in the liver, the pancreatic cell in the pancreas, the gastric cell in the stomach glands, etc., just like the brewer's yeast in the brewer's brew or the microzyma or the bacterium in the medium that can feed them. And each of these cells, in its center or in the appropriate medium, lives, that is to say, acts physiologically and chemically as an apparatus in which the materials of the medium are transformed. Yes, certainly, the cell is an important element of the organization! But, once again, it is a transitory organism, which does not fulfill the conditions of the essential organized element, autonomous, having the life in itself by primitive destination, that the philosophy seeks.

I repeat, this essential element is the microzyma.

The microzymas represent those elementary parts, monads or organic atoms which Henle sought without finding them; they are those primordial elements which, "dominated and held together by a power removed from our means of investigation, arrange themselves and develop themselves in accordance with a type." When I distinguished microzyma as a figurative ferment, I knew nothing of Henle's works, any more than I knew of Buffon's organic molecules or the authors' molecular granulations. Even after my medical studies, for a long time I regarded them as vulgar ferments, and with M. Estor I first looked upon them as the germs of bacteria; this was only part of the truth. Only later did I understand the high significance of their role, their physiological and pathological meaning...

Have confidence, and be reassured that many, led by Mr. Pasteur, reject microzyma only to mislead the opinion of the indifferent and to appropriate the ideas and the facts; they already call microzymas by various names; they impose them on those who do not go back to the sources. This would be a denial of

justice if they did not mix in serious and dreadful errors. In spite of everything, these attempts constitute a proof of the reality of the theory. Yes, trust me, the doctrine that stems from the discovery of microzymas is the doctrine of the future; what am I saying, it is already the doctrine of the present! Let's try to prove it.

## The egg and the cellular system

... let us penetrate more deeply into this idea, that the cell destined to become the egg is an individuality already distinct from the stem individual and that it has no other factors than microzymas having acquired the necessary aptitude.

And first of all this cell is quite different from all other cells, in the way it is able to fulfill its function. It is constituted and developed in a special organ which, itself, is constituted slowly and which its special function made called the ovary; when this cell has traversed all the phases of its development, without encumbrance, that it arrived at maturity and formed the ovum, all is not finished; it is necessary that this one is fertilized, i.e. that it is necessary the assistance of another organism which brings a new contingent of organic matter to it. In a word, to become the egg capable of reproducing a being similar to its parents, the ovum needs the agreement, the consensus of the 2 activities. Yes, the egg is a cell, but by this summary table, you see that one cannot say that this cell proceeds from another cell by continuity.

...

...the animal comes from 2 cells. And this is a law that applies to all higher beings.

…< different theories p.539 > …

… Let us consider the ovum already formed in the ovary of the hen. We have seen, in the last lecture, that the vitelline microzymas multiply, mature in the vitelline globules, by a sort of incubation. The vitellus, before becoming the seat of the transformations that fertilization and embryonic development bring, is thus an apparatus where a formation of cells takes place unceasingly, then their melting to put the microzymas in freedom, etc. At a given moment the ovum contains absolutely only molecular granulations. If, therefore, in the ovum a cell was produced which would be the origin of the future ovum, this cell would already be, as all the cells, the product of the activity of these molecular granulations or microzymas. This conclusion would certainly be legitimate. But this cell does not exist in the ovum, even fertilized, as we have seen, since 24 hours after the beginning of the incubation, one discovers only molecular granulations in the mass of the vitellus and in the nascent tissues of the chicken.

Undoubtedly, the works of the modern embryologists have taught us that it is already in the developed egg and become the fetus that the cell destined to become the ovum appears; but this appearance is late, it is preceded by the formation of the apparatus in the tissue of which it must be born, and this formation is itself preceded by particular organs, destined to disappear after having given birth to it.

…< following formation of the ovary p.541 – 542 >…

Küss, in his lessons, taught us that the essence of cellular life is, in addition to the rapid proliferation, the no less rapid destruction or death in the living being itself, whose structural unity remains despite these incessant changes. However, **let us not cease to remind it, that which is transitory, that which disappears to reproduce itself, cannot be the vital unity**. And then how to make the cellular theory intervene in the genesis of tissues where we have never seen cells: such as the vitelline membrane, the anterior and posterior elastic blades of the cornea, the capsule of the lens.

…< blast theory p.543 à 545 > …

It is < talking about the theory of blasts > the absolute negation of the cellular theory, it is the same of the protoplasma theory...

…< protoplasma theory p.546 à 555 > …

… The theory of microzyma is capable of completing the definition of the blastema and protoplasm and of bringing the demands of reason and the facts into agreement. The facts of anatomical generation without the immediate intervention of pre-existing cells are too indisputable for the blastema not to contain what prevents us from maintaining that these elements, cells and others, are the fruit of spontaneous generation. The blastema and the protoplasm contain, as I have already maintained several times, something organized, structured, living, which is the microzyma; it is it which is, according to the mechanism that I have explained, the producer of the cells and of the tissues without cells; and these microzymas, we have recognized them in all the tissues, ab ovo, endowed with chemical and physiological activity. They are the cause of the "continuous transformations" invoked by M. Van Tieghem and in whom reside the "transforming virtues" admitted by M. Pasteur; they are also the histogenic factors of the tissues; it is not only I who maintain this, you will be convinced.

## Applications of the microzyma theory prior to its discovery

Liégeois, in his treatise on physiology, applied the histogenic ideas of M. Robin. M. Grasset, at present professor at the faculty of medicine of Montpellier, has sought facts to prove that the microzyma is indeed the initial organized element which produces the egg.

> “To demonstrate this proposition," says M. Grasset, "I will invoke the descriptions of authors who did not know the microzyma and its role, who simply described things as they saw them, without taking sides.
>
> According to M. Robin, one sees at first a granular cluster; in this cluster the granulations condense and form a nucleus. "The nucleus (I quote verbatim from Liégeois, Traité de physiologie, p. 229) is surrounded by granulations united by amorphous matter (vitellus). Soon this mass is surrounded by an envelope which is at first excessively thin (vitelline membrane); then the nucleus becomes granular, then vesicular (germinal spot and germinal vesicle)."
>
> It couldn't be clearer: at first, microzymas and nothing but microzymas. They come together, pack themselves, secrete an envelope, etc.
>
> Shouldn't we say, from all this, that the first embryonic state of man is the microzyma?"

But so that the ovule thus formed becomes the egg, it is necessary the microzymas of 2 origins there. It is not enough that the egg is formed, it is necessary that it is fertilized.

The organized element which must complete the egg by fertilizing it, the spermatozoon, is also born in a particular glandular apparatus, which is like the ovary, and which one names testicle, gland of very complicated structure and richly vascular which also takes origin in the body of Wolff, etc. The testis contains a multitude of tubes, called seminiferous canaliculi, which are filled with cells, many of which are destined to produce the fertilizing element, the spermatozoon (zoosperms, spermatozoa, spermatic animalcules, zooplasts).

The cells in which the spermatozoa are born, like the egg, do not come from a pre-existing cell. In young subjects, these cells contain only fine granular material, mixed, in adults, with fatty granulations. Spermatozoa appear in these cells after a long period of time, which varies according to the species of animal, because sperm cells produce them only after a certain time. The authors have investigated the mechanism by which this happens. All agree on one point: it is that the spermatozoon is born in a cell where previously there was only a content, a blastema, a finely granular protoplasma, and that one cell, at least in certain animals, can produce several of them. I now give the floor again to M. Grasset:

> “And, he says, "the origin is exactly the same, if, instead of considering the ovum, we take the spermatozoon as our starting point. There is, at the page 195 of the Traité de physiologie de Liégeois, a figure which represents, according to Godard, the development of spermatozoa. It really

seems that the author wanted to represent the ideal type of tissue development by microzymas. And certainly neither Godard nor Liégeois can be suspected, when it comes to the theory of microzyma, of having seen only what they wanted to see. They show admirably first isolated granulations, then these granulations agglomerated without envelope; then with an envelope; then packing inside, they form the head of spermatozoon, etc. Liégeois admirably saw and depicted in the frog the tail forming little by little in a string, then in a stick, always by the addition of granulations. "He says, "we see moniliform filaments **due to the juxtaposition of these granulations**.

And he concludes by saying: "Our observations have led us to admit, like Godard, that the spermatozoa, in the whole animal series, are formed by the aggregation of a certain number of granulations."

**One cannot better put it in other words, that man, and in general every animal, comes out of the microzyma**.

The microzyma is thus truly the vital unit, since it is at the same time the last anatomical element of our tissues, the first term of the animal series and the embryonic principle of any organism.

It is therefore with the greatest reason that the microzyma must become the basis of a complete and new theory for normal histology and, consequently, for pathological histology.»

I add that it is impossible, when considering carefully the figures which in the book of Liégeois, represent the spermatozoids of the frog, not to think of the bacterial evolution of microzymas. In making this remark and this connection, I assure you that I am not violating in any way the author's thought. Listen to:

"The frogs present this particularity which, we believe, is exceptional, it is that one finds in their testicles spermatozoids at all times of the year. Only, their development, their form, are essentially different in winter and in summer.

In winter, we find, in the testicular sperm, rounded cells, always containing a very distinct nucleus, in addition to numerous granulations distributed in the interior of these cells. It is at the expense of these granulations that the spermatozoon is formed; in certain preparations, in fact, one can observe in the cell the presence of moniliform filaments, due to the juxtaposition of these granulations (p. 196-199).

In other cells, much more numerous than the former, there are straight and coiled bundles of spermatozoa, and these cells have only a very limited number of granulations. In all cases, the nucleus of the cell remains intact, and therefore does not contribute to the production of spermatozoa. At some point, the cell ruptures and the bundle of spermatozoa that it contains escapes. While this bundle has left the cell, the spermatozoa remain united by one of their ends with the granules that were not used to form them. These granulations are, moreover, animated by extremely rapid movements which tend to dissociate the filaments; it is they which, without doubt, have been taken by the authors for the heads of the spermatozoa. But the spermatic filaments of the frog are without heads, they are in the form of filaments tapering at both ends, more tapered on one side than on the other, on the side which corresponds to the direction of the movement...

It thus results that in batrachians, spermatozoids develop in winter in the interior of the spermatic cells; in summer, in the interior of the nuclei; **but that in all the cases, their development is done by the union between them of the granulations contained in the cells or in the nuclei**. These granulations are, therefore, the most essential elements for the formation of spermatozoa; they acquire an even greater degree of importance, when we consider the phenomena they present, when, not having served for the origin of spermatozoa, they have come out of the cells and nuclei.

> These granulations, which are capable of taking on a certain development, while remaining more or less rounded, move with extraordinary rapidity, just like the spermatozoa. If they are still in connection with the heads of filaments condensed into bundles, they seem to make an effort to dissociate them from each other; if they are completely free, they execute the most bizarre and singular movements in all directions indiscriminately, movements quite different from Brownian movements. Finally, it may be observed often in the sperm of the frog, observed in summer, that the nuclei do not always result in the formation of spermatozoa; large granulations replace them, and these granulations escape from the nucleus, carrying with them a part of the substance of the latter, preserving, as it were, the movement which the spermatozoon should have possessed, if it had been formed at their expense (Pl III fig.4 et 5). »

…The spermatozoon is the product of microzyma: just like a bacterium, a vibrio, a cell. Liégeois still provides me the demonstration of it.

...In short, the male organism produces the fertilizing matter by a mechanism comparable to that by which the female organism forms the ovum; and so that the fertilizing egg is constituted, it is necessary that a certain quantity of fertilizing matter unites with the matter of the ovum; ...

... suffice it to say that this penetration has been directly observed and, moreover, that the spermatozoa, having reached the vitelline substance, disappear there so well that no trace of them can be found. I have tried to demonstrate directly this resolution of the spermatozoa into microzymas in the vitelline matter; but there are great difficulties there which do not allow me yet to pronounce myself definitively.

... In short, **for the egg to be constituted, it is necessary that there are microzymas of the 2 origins, those of the ovum and those of the spermatic cells of the same animal species**. And this point of view will explain us many things in the physiological order and in the pathological order.

…< other examples where microzymas in action are described p.563 > …

… But that is enough; with what I have told you in the third lecture, you now have the elements of the reasoned conviction that none of the systems successively invoked or adopted by the scientists: mechanical theory, cellular theory, theory of the blastema or of the protoplasm, is in a position to account for the physiological facts concerning the genesis of the cells and to explain the mystery of the generation.

The theory of the microzyma, on the contrary, leads to a great unity. The microzymas are structured and alive; they can multiply and communicate to the matter which serves for their multiplication the property which is in them, the chemical and physiological activity which characterizes them, because they transform this matter into their own substance and it becomes what they are. In the organism, the cells, all the cells, are first of all the fruit of their activity, and these cells, in their turn, being constituted, I repeat, are apparatuses in which the microzymas acquire new aptitudes, undergoing there a kind of incubation, while they multiply: Thus, vitelline microzymas become microzymas of the liver, microzymas of the pancreas, microzymas of the peptic cells, nervous microzymas, microzymas which, at a given moment, will acquire the fertilizing property in the spermatozoon, etc.

These are not gratuitous assertions, but established facts ....

Let's affirm now that the theories which are current in science, have been impotent when they pretended to answer the 2 questions:

"What is, for a living being, to be organized?

"What is living matter?

We are going to try to give the answer, based on the whole of the facts concerning the history of the microzymas and in accordance with the demonstrated propositions which legitimize my postulatum.

## Of living matter and organization

In all the courses of these lectures, I have reasoned in the hypothesis that microzymas are organized, structured; and this pleonasm is necessary, since it is admitted that there can be organization and life in the unstructured matter called blastema or protoplasma, that is to say in an assembly of purely chemical principles.

However, scientists, considering protoplasmas and blastèmes as living substances, although formed only of water and a greater or lesser number of various chemical compounds, are very much embarrassed, so much so that the notion of life seems to them to require something more than the purely chemical properties in the matter they consider as living. This is why everyone, seeking the cause which makes living matter differ so profoundly from purely chemical matter, adds something extrinsic to the latter. This is how :

**Mr. Robin** supposes that the chemical components of the blastema are united molecule to molecule, by special combination and reciprocal dissolution. ...

C**l. Bernard**, after having said that the protoplasm is a chemically defined body, as if embarrassed by the enormity of the assertion, recovers and adds: "or at least, by its physico-chemical constitution". He had moreover expressed his way of seeing more explicitly: "Wherever matter exists, this matter is subject to the general laws of physics and chemistry; but in living beings, the action of these laws is closely linked to a host of other influences that cannot be denied < ref. p. 565 >. »

**M. Pasteur** assumes that the purely chemical matter of protoplasma is endowed with transforming virtues which heat destroys. And his disciple, M. Van Tieghem, recognizes in it a way of continuous transformation.

As you can see, when they look closely at it, the physician, the physiologist, the chemist, recognize that there is life only in what is different from purely chemical compounds.

It is necessary to maintain, as a proven fact, that there is only life in what is organized; that living matter is organized matter. This is what I will demonstrate. But first, to avoid any amphibology, let us see what is the meaning of the words "living matter" in biology...

...< definition of "organize" and derivatives p. 566 > ...

This is what the dictionaries say. To organize matter to make it fit to live, to be animated, is to shape it and arrange it into organs as the artist shapes and arranges the organs, the cogs of a machine .... And the organization, it is the learned arrangement of the parts towards a determined goal.

Organization and ability to live are for the matter correlative things. **The conditions of the manifested life are the organization and the appropriate environment from which the organism borrows the elements of its nutrition.**

Organization presupposes parts, organs, and consequently structure; and you have just seen that the dictionaries call organic matter that is organized.

I must call your attention to the amphibology to which the word organic lends itself.

...< p. 567 >...

Now you know that, since Lavoisier, organic matter is no longer considered to be of special essence. It is mineral by its components. The immediate principles of animal or vegetable origin are combinations of carbon, hydrogen, oxygen, nitrogen, united 2 to 2, 3 to 3, 4 to 4, the carbon always present. They are called organic matter because of their origin, and they are studied, in that part of science called organic chemistry, by the processes and methods of mineral chemistry. The immediate principles can be acids, bases, alkaloids, amides, salts.... Far from defining them by their origin, they should be called not organic compounds but combinations of carbon, because this simple body is the constant and necessary element of the composition of any immediate principle.

There is therefore no organic matter by essence: all matter is mineral by its components....

...Undoubtedly, the matter of organized beings, as a whole, contains several of these immediate principles, but associated with purely mineral immediate principles: a lot of water,…

…< quotes from J. Muller and Liégeois p.569-570 > …

Thus, the organization, that is to say the state of an organized body, results from the concurrence of immediate organic principles, I mean more or less complex combinations of carbon, and immediate mineral principles. This is the matter which can live, which lives and which, without the help of any other factor, will generate an epithelial cell, a fiber, an anatomical element of any kind and, consequently, an ovum, a sperm cell, a spermatozoon, an egg, a man! For, weigh well the terms used by J. Muller and Liégeois, and you will recognize that the consequence is inescapable.

Is it true, is it experimental? Can organic matter, conceived according to these systems that I have just quoted, and with the scientific notion of the exact nature of what is called the immediate principle, be considered a living substance? No, certainly not, since each of the terms of which it is composed is mineral in essence and it is not said that there is living mineral matter. Let us make it obvious ...

... Let's take again the experiment of Mr. Pasteur on blood...

Blood is one of the most complex mixtures of immediate carbonaceous principles and mineral compounds that the organism provides. By the disposition of his experiment, Mr. Pasteur did not destroy the virtues of transformation that by hypothesis it concealed, because he did not apply heat to it, and he put it in the presence of pure air, that is to say in the most favorable conditions to the life of the blood .... Well, this mixture left at physiological temperature, what happened to it? ... it died, in the sense that the red and white blood cells disappeared and nothing replaced them. In short, Mr. Pasteur's experiment goes straight against the hypothesis that protoplasma generates the anatomical elements. I have explained to you that the microzymas of the globules and those which exist primitively in the blood have destroyed these globules and produced the observed transformations. I add, having carried out the experiment, that if one takes care to dilute the blood in water and that by a careful filtration one removes all the microzymas, after a sufficient addition of creosote or phenic acid, one preserves indefinitely the blood materials.

A second example is the material of the hen's egg.

The fertilized hen's egg certainly contains all that is necessary to produce not only a chicken, but at least the cells and other anatomical elements of that bird; provided that it is supplied with a sufficient quantity of pure air and a determined and substantially invariable degree of heat, the bird will be born!

If one comes, by strong enough shaking, to mix everything in this egg and that one then subjects it to incubation, what will happen? No chicken will ever come out of it, and the most skilful man will not be able to give it its first texture. ... Even less than that is needed: if the incubator lets the unscrambled egg cool down a little, it is finished, there will be no bird. All the necessary material is there however. What happens in the scrambled egg that is submitted to incubation? **Has what was alive in it been killed? No, but it has acted under other conditions**: instead of forming tissues and determining the chemical reactions necessary for the formation of the substances which must take place during the further development of the animal, it has acted for its own sake, selfishly: it has fed, multiplied, and other combinations have been generated. In short, the microzymas of the egg yolk acted as ferments do, and as we have seen, the alcohol, acetic acid, carbonic acid, and hydrogen released or formed were at the expense of the glucogenic materials and the glucose of the egg; the albuminoid materials are found substantially intact.

…< suite p. 572 à 574 >…

## Composition of microzymas

The microzyma is organized, structured; it is morphologically defined, to speak as Cl. Bernard; it is endowed with multiple activities: chemical, physiological and histological. In the 7th conference, I made known to you their elementary composition...

... the elementary composition of microzyma in the egg, in the liver, in the pancreas is more or less close to that of brewer's yeast and albuminoid substances. Immediate analysis reveals fats and minerals. And the more detailed analysis of the microzymas of the hen's egg yolk has revealed several albuminoid substances, one of which is a zymase...

... The composition of microzymas in their physiological state admits 80% of water in their tissue. They thus satisfy by their composition all the conditions of life.

Nencki and Schaffer have cultivated pancreatic microzymas in half-fine gelatin, i.e. impure and containing salts. They multiplied and partially transformed into bacteria...

…. < analysis p.577> …

…. < suite -> p.590 > …

# 11th conference

A microzyma, if it could speak, parodying the poet, would write: I am organized and I am alive; nothing that is organization and life can be foreign to me! Indeed, you must be convinced, the microzyma is really organized; and it is alive from three points of view: chemical, physiological and histogenic; in it are summarized all the notions that we possess concerning matter. The protoplasma, the blastme, considered as essential living matter, are alive only by the microzymas which they contain; the cell itself, constituted in the state of an organ or independent organism, is the fruit of the life and energies of the microzymas which have formed it: it is transitory and, when it is destroyed, or when it destroys itself, its microzymas reappear with the ability to reproduce or to evolve into bacteria, according to the conditions in which they are placed; and these free microzymas summarize certain activities of the cell. The postulate that I formulated at the beginning of the tenth conference is demonstrated by a series of decisive experiments, which have been verified by several scientists, even those whose minds, imbued with common scientific prejudices, were most reluctant to accept the evidence!...

…< following considerations on the organization according to the different theories p. 592 – 593 > …

… The virtues of transformation which are not linked to the morphologically defined organization, are nothing, and M. Pasteur may defend himself, but he is as well as M. Joly and M. Pouchet, a spontépariste without knowing it!

... It is no longer a question of the rather vague questions that Needham and, closer to us, Pouchet, were agitating! It is the spontaneous birth of the microzyma that one must demonstrate. It is at this precise point that my researches have reduced the problem of the genesis of the tissues of superior beings as well as of infusoria, ciliated and non-ciliated, and of microphytes. **Without microzymas, there is no organization, and without structured organization, there is no life**: this is what we must admit today as the expression of the absolute truth..

… < another fermentation experiment by Méhay, taken up by J. Béchamp showing the activity of air microzymas p.596 > …

Yes, the atmospheric microzymas fell into the almost mineral environment of Mr. Mehay and adapted to it and, if I may say so, with the help of the materials they had at hand, they synthesized the cellulose and nitrogenous matter, etc., which they needed to multiply and to evolve into vibrios, then into bacteria...

**Yes, this marvelous virtue of adaptation to environments, of microzymas, their vital resistance, their perennity, I would say willingly, explains how and why they are imputrescible**, as they are found in chalk, in many limestones and other rocks, in several mineral waters, in the soil and even, as demonstrated by M. Le Ricque de Monchy, in commercial bicarbonate of soda.

Here we are brought back to the solution of the problem of the origin of microzymas, since this experiment, like so many others, shows them possessing an independent existence with a powerful physiological activity.

And about this question of origin, I do not want to raise a metaphysical discussion. I will remain in the field of observation and experience by searching with you where the atmospheric microzymas come from.

These are proven, verified, controlled facts: Yes, there are atmospheric microzymas, and there are geological microzymas: ...; and all living beings contain them, not accidentally in this or that point of their organism, but necessarily since they are the agents of the chemical actions which are accomplished there, the factors of cells, the builders of their anatomical elements and of all their tissues. And these microzymas, which were confused under the name of molecular granulations, amorphous matter supposed to be without structure and without life...; which the scientists were only concerned with to declare their

insignificance; which did not hold any place in their doctrinal theory; Yes, these microzymas have today their place, a very great place, in the sun of science! They impose themselves even to those whose preconceived systems they disturb!

And all these microzymas of so diverse origin, endowed with variable chemical activity, have a common aptitude: that of evolving to appear in the form of bacteria and of all the morphological states, vibrios, amylobacters, which precede the bacterial form. Finally, it is thanks to these microzymas that I was able to explain the experiments of the spontéparistes, which Mr. Pasteur left without explanation…

… < long presentation concerning Pasteur's misleading speeches on microzymas in order to ridicule A. Béchamp's theory p. 598 à 605 > …

## Origin of atmospheric microzymas

It is very important to know if those of the atmosphere are of particular species made on purpose and unrelated to the microzymas of organized beings, plants and animals of all kinds?

….< p. 607 > …

By researching the origin of atmospheric microzymas, I may be able to clear up the misunderstanding that is in the minds of many scientists who, unlike Mr. Pasteur, seek the truth without bias.

… < explanations on the confusions of the researchers between the microzymas and the miccrococcus of Hallier p. 608 à 613 > …

The micrococcus are ultimately only vegetable productions which, far from being the necessary anatomical elements of the animal organization, are only accidental hosts and harmful hosts: indeed in his Parasitological Researches (Parasitologische untersuchungen), M. Hallier claims to find them in smallpox, vaccinia, scarlet fever, cholera, typhus, etc.

…< p. 613 à 616 > …

## Synthesis of organic matter

Thanks to the immortal statements of Lavoisier and especially to the work of M. Dumas, who made them known to us and who demonstrated their experimental reality, we know that, in the general system of the living world, the plants are, thanks to a marvelous activity, the place where mineral matter becomes organic and is organized. Animals feed immediately or mediately on the organic and organized matter of plants, assimilate it after having made it undergo some modifications by digestion and constitute their tissues by appropriating it. **The function of plants is therefore to synthesize the organic matter that animals consume. The plants are thus the synthesis devices which, during a phase of their life, feed on mineral matter which they draw from the air, water and earth**.

During their lives, animals constantly return to the atmosphere the organic matter they have borrowed from plants: carbon in the form of carbonic acid, hydrogen in the form of water vapor, nitrogen free or combined with hydrogen, or with hydrogen and oxygen in the form of ammonia or its derivatives, etc.; to the soil, purely mineral matter, in the form of sulfates, chlorides, fluorides, phosphates, carbonates, and silicates of the various metals of the organization.

Without animals, vegetable matter would accumulate continuously, and the plants would sooner or later perish for lack of food, through congestion or otherwise. But without plants, the animals would soon all perish from a dreadful dearth; organic nature itself would disappear entirely in a few seasons.

For the harmony of the organized world, it is therefore necessary that all organic matter become mineral again.

**Animals burn a great part of the organic matter by a physiological phenomenon. They operate as if they were analytical apparatus: precisely the opposite of plants.**

But it is necessary that after death; the animal matter, in its turn, disappears and returns to the atmosphere and to the earth. What is the agent of this necessary and total destruction?

## Destruction of organic matter

During life, the agents of respiratory combustions are the anatomical elements of the organization and in vertebrates especially the blood cell. Thanks to their help, the oxygen burns continuously the organic matter of the tissues and liquids of the organism. But, after death, what is the agent capable of communicating to oxygen, without the help of a high temperature, its oxidizing properties and, thanks to its help, of giving back to the elements the organic and mineral matter of the animals, which, without this, in its turn, would accumulate and make life impossible?

Lavoisier assumed that fermentation was responsible for bringing about, in part, the return of organic matter to the mineral state, and, in speaking to you of the physiological alterations of urine and the fermentation of urea, I will tell you that **M. Dumas admitted in a very clear way that it was a ferment supplied by the organism itself!**

## The total destruction of living beings

You know that 2 opinions are present about the ferment or ferments that operate the total destruction.

- One, that of M. Pasteur, is that after death, there is no longer anything living in the organism. The cause of the return of organic matter to the mineral state is external to the animal and, moreover, he recognizes that this cause is discontinuous; it is to deliver a phenomenon as necessary to the chance of panspermia!
- The other, mine, you know: **the animal, like any organized being, carries with it the initial cause of organization, of life, in the physiological and chemical sense, of disease and of total destruction after death**. It recognizes that the creator has left nothing to chance in the admirable system of the circulation of matter in the living world.

It is by studying the transformations, histological and chemical, which are accomplished in a tissue removed from the germs of the air, that I was able to definitively demonstrate this great law and to discover the microzymas which remain after the total destruction of an organism. I will briefly summarize what is scattered in these lectures; we will then discover that the atmospheric microzymas are nothing other than the microzymas of the destroyed organisms.

... Fermentation < airborne germs removed > of eggs and liver is accompanied by a release of gas: it is a mixture of carbonic acid and hydrogen; the law of this release is as follows: carbonic acid predominates at first, then becomes approximately equal, in volume, to hydrogen, then predominates again, with hydrogen going down.

The eggs and liver provide alcohol and acetic acid, and the phenomenon, for the eggs at least, being prolonged, a little butyric acid. In the fermentation of the liver there is also lactic acid.

Glucose and organic matter disappear.

Albuminoids and fats remain apparently unaltered or little changed.

The cause of the fermentation for the eggs was none other than the normal microzymas, found unprocessed. For liver, there were no other organized forms than microzymas, strings of microzymas and bacteria resulting from their evolution.

For meat, things happen in the same way; ...

These facts have been confirmed in every respect by Messrs. A. Gautier and A. Etard. These chemists operating on several hundred kg of horse and beef meat ...

... After this first phase coinciding with a release of nitrogen, other products appear, characterizing the putrid fermentation. Then all gassing stops, the work of decomposition ceases, the muscle retains some of its coloring and shape, and seems to have passed into a rot-proof state.

I add that **Messrs. Gautier and Etard have noticed that the large bacteria of the beginning disappear then replaced by very small bacteria, often tremulous, and with refractive heads, straight or sinuous, mixed with punctiform ferments** (microzymas).

So the liver and the muscle separated from the mass of the animal to which they belonged, are not, therefore, carried over in the order of dead substances, since bacteria appear there, which are living organisms; their essence is not completely changed, since the microzymas which produced alcohol there during life, produce the same alcohol and acetic acid there still for some time. But why do these microzymas become bacteria under these conditions, while they are not found in the same organs and in any tissue of a healthy organism? And why do the bacteria of the first phase disappear to be replaced by new ones and by punctiform ferments (microzymas)? This question will be examined later. Before doing so, it is necessary to mention another experiment of Messrs. Gautier and Etard. They also studied the fermentation of fish flesh. The phenomenon is a little different.

The learned chemists, operating on 60 kg of scomber scrombus flesh, noticed that the mass became alkaline from the beginning; that only very little hydrogen was released, 4 to 5%, and 96 to 95% carbonic acid; then on the 16th day, almost pure carbonic acid: and the muscle mass continued to be transformed more and more.

It is regrettable that the authors of these important observations have said nothing about the organisms involved in the fermentation of fish flesh; **but we must be grateful to them for recognizing that the transformations ... are due to a ferment of its own**. This is how the truth will gradually emerge, and how people will no longer believe in spontaneous transformations, in the doctrine of alteration, and in the indispensable necessity of germs in the air to explain the putrefaction of meat, etc.

... < p. 621 > ...

It is necessary to understand that in the conditions of my experiments, as in those of Messrs. Gautier and Etard, the complete return to mineral matter is impossible. Consider the alcoholic fermentation in a closed vessel, not admitting the intervention of air germs...

...< explanation of chemical reactions p. 622 – 623 >...

Thus, the organic matter needs, to return definitively to the mineral state, several successive fermentations, as Mr. Dumas had so clearly expressed it, and I add that it needs the intervention of several fermentations, under various conditions. The animal matter after death destroys itself, thanks to the microzymas of its tissues, put violently in a new situation. But **this destruction, which annihilates the organization**, results at first only in the transformation of a small quantity of its carbon and hydrogen, into carbonic acid, water and free hydrogen, coming from the glucogenic matter or from the substances called carbohydrates. At the same time, other still organic combinations are born, which remain with the albuminoid materials, which were said by Liebig to be so changeable, and which are then more or less transformed themselves, without changing in their essence, by the microzymas that have become bacteria. In order for the albuminoid substances to be burned in their turn, they will undergo new transformations by other ferments, but in sum, as in alcoholic fermentation, the new substances and the ferments would remain in the state they have reached if a new influence did not intervene: what is this influence? It is none other than oxygen, as I have just told you about the destruction of acetic acid!

Everyone knows that a corpse buried in the ground is usually nothing more than dust: ... even the coffin itself is soon gone! And what resists the longest are the bones, the organs less rich in microzymas, or those whose microzymas are endowed with the least activity!

But if the corpse has been embalmed or kept at a very low temperature, the microzymas are rendered mute, and the organic matter is preserved, as it were, indefinitely.

Let us therefore deal only with the case where the destruction has really taken place and let us note what remains of the matter of the corpse. This will enable us to show you that **the microzyma is the only element of the organization whose life persists after the death of the individual it served to build**, and also to discover the source of the atmospheric microzymas.

… < experiments "burial of animal and extracted organs" in carbonate lime, remains analyzed after several years p. 624 à 628 > …

Let us conclude all these facts so well linked:

1. That the only non-transitory anatomical elements of the organism that persist after death and evolve to form bacteria are microzymas.
2. That in the organism of all living beings, at some time, in some part, even in man: alcohol, acetic acid and other compounds are produced which are the normal products of the activity of what are called organized ferments, and that to this production there is no other natural cause than the normal microzymas of that organism. And this presence of alcohol, acetic acid, etc. in the tissues, reveals to us one of the causes, independent of the phenomenon of oxidation, of the disappearance of sugar in the organism, of glucogenic matter and of what M. Dumas has so rightly called respiratory food.
3. That, spontaneously, that is, without the aid of any external influence other than a suitable degree of heat, a part removed from an animal: eggs, milk, liver, muscle, urine; or from a vegetable: a seed that germinates, a fruit that ripens being detached from the tree, etc., ferments. The fermentable matter that disappears first in an organ after death is glucose, glucogenous matter or some other compound called carbohydrate, i.e. a respiratory food! And the new compounds that appear are the same ones that occur in alcoholic, lactic, butyric fermentations, in the laboratory or during life ... _ I have shown that brewer's yeast, while it destroys itself by autophagy, produces leucine, tyrosine, etc. Now, Messrs. Gautier and Etard have proved that analogous products are formed during the spontaneous putrefaction of meat, which demonstrates the functional analogy, at a given moment, of the microzymas of yeast and of the animal microzymas evolved into bacteria, etc.
4. That it is thus demonstrated once again that the cause of decomposition after death is, in the organism, the same one that acts in other conditions during life: Namely: the microzymas capable of becoming bacteria by evolution.
5. That the microzymas, before or after their bacterial evolution, only attack the albuminoid or gelatinogenic materials after the destruction of the so-called carbohydrate materials.
6. That the microzymas and the bacteria having operated the transformations we have spoken of, in closed apparatuses, in the absence of oxygen, do not die; they return to rest, like the brewer's yeast in the products of the decomposition of sugar that it has operated.
7. That it is only under certain conditions, and thanks to the intervention of oxygen, as in the experiments of the little cat buried in the carbonate of lime, or under other conditions, following new fermentations, that the microzymas or bacteria operate the definitive destruction of the vegetable or animal matter, reducing it to carbonic acid, water, nitrogen or very simple nitrogenous compounds, or even to nitric acid, that is to say, to nitrates!
8. That it is thus that the necessary destruction of the organic matter of an organism is not left to the chance of causes foreign to this organism and that, when everything has disappeared, the bacteria

> and finally the microzymas result from their regression, remain as witnesses that there was nothing primitively alive but them in the destroyed organism. And these microzymas which appear to us as residues of what has lived, certainly still possess something of the activity, of the kind of specificity, which they possessed during the life of the destroyed being: it is thus that the microzymas and bacteria residues of the corpse of the little cat, were not absolutely identical to those of the liver or of the heart, of the lung or of the kidney.

And in order that this theory may not take on the appearance of a preconceived system in your eyes, let me assure you that I do not mean to say that, in the destructions effected in the open air, on the surface of the ground, other causes do not concur in hastening them. I have not denied that what are called germs in the air or other causes are active; I only say that these causes have not been made on purpose for that purpose; what are called germs in the atmospheric dusts are nothing else than the microzymas coming from organisms destroyed by the mechanism that I have just exposed and whose destructive influence is added to the one of the microzymas proper of the disappearing being! But there are not only microzymas in the atmospheric dusts; the spores of all the microscopic flora can intervene, as well as all the moulds which can be born from these spores; and it is not all: M. Dumas traced the following striking picture of the thousand causes which disperse and destroy the organic matter: … < p. 630 > …

… < Pasteur's theory, putrefaction: only cause the germs of the air, then he affirms that it starts with the vibrios of the intestinal canal p.632-633 > …

It is clear that M. Pasteur has not made any medical studies, nor has he performed an autopsy, otherwise he would not have written something so obviously inaccurate... M. Ch. Robin has no difficulty either in showing M. Pasteur's error: he expresses himself as follows:

"... for if after death, gases begin to develop, as in the living, as a result of the continuation of the chemical modifications of the intestinal contents, it is quite certain that the presence of bile prevents the putrefaction of these contents and of their container. The blood in the vessels, the spleen, the stomach, the liver, and sometimes even the lung and heart putrefy before the intestine itself, both in the case of death by disease and by submersion… < p. 634 > … ».

It is therefore exactly the opposite of what Mr. Pasteur thinks that is true. Moreover, it is wrong for Mr. Pasteur to attribute exclusively to air germs the presence of infusoria in the intestine; we know that, if there are any of this origin, the greatest number comes from the microzymas of the buccal mucosa, of the stomach and of the intestine itself, as will be more amply demonstrated when we deal with the microzymas in the diseases.

…

## Oxidation phenomena

… I was led to ask myself why oxygen acquired such great oxidizing energy in the human organism, or in red-blooded animals.

It is known that the red blood cell absorbs oxygen, condenses it; I have admitted that oxygen thus condensed acquires the oxidizing property in the cell, in the same manner as it acquires it through the sponge or the platinum black. So that the blood cell is the necessary apparatus of the respiratory function.

… < Pasteur's hypotheses refuted by M. Berthelot p. 636 – 637 > …

Mr. Berthelot's assertion that fermentation by brewer's yeast is accomplished very well in the presence of free oxygen was the result of a work in which I had proved that fermentation, all things being equal, lasts longer when, from the beginning, one eliminates the air from the apparatus by a stream of carbonic acid, and that the quantity of acetic acid decreases in contact with the air and increases, on the contrary, when, from the beginning, one suppresses the air. And to make the demonstration indisputable, I operated fermentations, while, by a current of the pile, I decomposed the water in the presence of sugar and yeast.

The oxygen of the decomposed water was absorbed and the carbonic acid was released mixed with hydrogen. And I proved that sugar water absorbed oxygen as well as yeast.

But the higher organisms are all so made, that all the functions of their tissues are accomplished within liquids impregnated with oxygen: there is oxygen in the milk, there is oxygen in the liver, in the muscular fluid and even in the urine. The cells, the microzymas of all these parts are therefore, to use Mr. Pasteur's expression, aerobic: in spite of this, there is alcohol in the milk, in the liver, in the meat, in the brain and even in the urine, and alcohol is indeed a product of fermentation. But after death, while putrefaction is going on, in closed vessels, oxygen disappears, hydrogen is released with carbonic acid, a little hydrogen sulphide is formed, and combinations are formed which can directly, like the latter, absorb the oxygen which could have remained there: it is therefore the aerobic microzymas which have started the fermentation!

... Let us go to the bottom of things.

What Mr. Pasteur does not see yet, are these admirable harmonies of which an attentive study of the phenomena reveals to us each day the astonishing reality; the learned chemist always appears to me as an indiscriminate finalist, when he persists in considering the organisms, such as the brewer's yeast, the bacteria, the microzymas that he calls microbes or micrococcus, as beings created for a determined end, forming a category apart among the living beings! Possessed as he is by his system, he cannot imagine that any organized being exists first of all for itself. ...

We have considered in the beings that are improperly called ferments,

- The chemical function by the zymase which it can secrete, and which is used to prepare its environment;
- And the function of nutrition which is the condition of formation of this zymase as well as of the conservation of its being, of the individual which it constitutes.

… In beings reduced to the state of a cell ... as well as in the cells of more complicated organisms, where the division of work reaches its last limits, as in man, we can consider 2 superior functions: the function of conservation and the function of multiplication, which are laws. These functions are of a purely physiological order... of all beings without exception.

…

## The conservation function

But in the functions of conservation and multiplication, the function of nutrition is included, as a means, and it is here that chemistry can help physiology.

The spirit of the system admits of a special ferment for each species of fermentation: there would be an alcoholic ferment, a lactic ferment ... and I mean here only the organized ferments; what would it be if I wanted to add to them the non-organized ferments or zymases, which were thought to be independent of these?

The first time I spoke out against the system of specific ferments was in a letter to M. Dumas of December 2, 1867, on the occasion of the fermentation of alcohol by the microzymas of chalk .... In this action these microzymas had not changed aspect ... they formed caproic acid and acetic acid! Now the ferments, resulting from one of these operations, having been put with a solution of cane sugar, ... formed in 3 months 340 gr of lime lactate, a little butyrate and acetate; and the ferments coming out of this operation operated just as easily the fermentation of the starch starch, producing butyric acid and acetic acid!...

… < example in which Pasteur could have made this observation p.640 > …

It is thus very rightly that I could write : "We have the proof that the microzymas of the chalk are not specific ferments ; in general, there are none ; what there is, they are organisms which provoke or operate transformations depending on the food which one provides them.

In short, **an organized ferment is a living apparatus, whose chemical function can change correlatively to the species of fermentable matter that it is forced to consume, and to the conditions of the environment where it is forced to act**.

… < examples of adaptation to conditions p.641-642 > …

## Vital Resistance

But the faculty to adapt to the environments is all the more accentuated, that the organism is of lower order, simpler in its organization, closer to the microzyma, so that there are some which are not even killed by the desiccation.

… < examples desiccation - high temperature - extreme cold p.643-645 > …

Let us conclude from all these facts that the lower beings have a very great aptitude to adapt themselves to the environments; that those who are at the bottom of the scale can dry out, undergo very extensive variations of temperature without perishing, that is to say without losing the faculty of manifesting again all the attributes of life. This explains very simply why microzymas are found alive in chalk, in street dust and in the air.

I have spoken to you mainly about the total destruction of an animal organism; but this theory is applicable to plants, since these are also formed by microzymas that can evolve into bacteria, which are able to act as ferments: there is no exception. **And we must not imagine that the return of bacteria to microzymas can only be done thanks to the help of oxygen**. There are other conditions for this regression. I have more than once ascertained that the best characterized bacteria, even the leptothrix, developed in a given medium, with the apparatus remaining closed, after a few weeks or months, were reduced to microzymas. But we shall return to these facts from the pathological point of view.

... Animal and vegetable microzymas have other properties in common.

## Action of organic and organized matter on oxygenated water

…< p. 646 à 656 > …

A careful study of these interesting phenomena has allowed us to recognize:

1. That all organized matter does not give off oxygen from hydrogen peroxide;
2. That the organized matter which possesses this property owes it to its microzymas, which at the same time undergo some alteration in their substance;
3. That the organized matter or the microzymas lose the property of releasing oxygen from hydrogen dioxide by the action of a sufficiently high temperature and, perhaps, by the influence of certain agents, of hydrocyanic acid, for example;
4. That the cause of the release is not the same in a microzyma or an organized substance, and in a metal or certain oxides;
5. That organic matter, which is an immediate principle, causes the release of hydrogen, even when it has been heated to a temperature capable of effecting some modification, as happens with hemoglobin, which coagulates and becomes insoluble;
6. That among the characteristics of certain organized substances and of certain microzymas, we must count their property of releasing oxygen from oxygenated water.

Fibrin and its microzymas, after having exhausted their decomposing activity, no longer fluidify the starch and no longer produce bacteria. Could it be because the microzyma has been killed, that the zymase, which in the microzyma fluidizes the starch, has been destroyed? One should not hasten to conclude.

Indeed, I have ascertained that sialozymase and saliva, mixed with hydrogen peroxide, saccharify the starchy material with as much intensity as without this addition, and that the oral organisms, well washed with a great excess of the same hydrogen peroxide, are almost as active as before this treatment.

On the other hand, the yeast which has undergone the action of hydrogen peroxide interacts with the cane sugar.

… < experience p.657 > …

As you can see, the yeast is not killed, and we have here a new proof that alcoholic fermentation is not life without air. Yeast is neither aerobic nor anaerobic, since it can live with and without oxygen.

…

## What is the origin of atmospheric microzymas?

**It has been demonstrated that all organs of all currently known living beings, plants or animals, without exception, including those designated as ferments, bacteria and others, are, by regression, reducible to microzymas.**

Since I discovered the microzymas: in my experiments on the reversal, which was believed to be spontaneous, of sugar water; in the air, in the molecular granulations of fermentations and various natural liquids, such as wine, milk, urine, etc.; in the tissues and organs of animals and plants; I have searched for them wherever it was rational to do so as a consequence of the theory, namely: in other rocks than chalk, in cultivated earth, in the soil, in the water, in the soil, in the soil, in the soil, in the soil, in the soil. In the tissues and organs of animals and plants; I looked for them wherever it was rational to do so as a consequence of the theory, namely: in other rocks than chalk, in cultivated soil and loam, in the virgin soil of the garrigues of the department of Herault, in the mud of marshes, in the dust of the streets of our cities! I found them in several mineral waters, either in an isolated state or gathered in masses that were believed to be anhistory, as in the glairine of Molitg; and I am convinced that if one searched well, one would discover them in the waters and muds of geysers and salzes or muddy volcanoes: the nature and the origin of the glairine guarantees me the validity of this opinion.

In the rocks of the quaternary, tertiary, secondary and transitional terrains included in the periods of formation called homozoic, neozoic and paleozoic, they represent the living remains, of the various beings that lived in these remote epochs. I have even come across real living bacteria in some fairly modern freshwater and marine limestones!

In the cultivated soil and in the compost studied on the spot in the mountains surrounding St Pons in the Hérault, where it is not rare to discover bacteria with microzymas, they come from fertilizers, from the detritus of the plants which develop and perish there each year.

In the mud of the marshes, they are, in the same way, the result of the decomposition of the vegetable and animal matters of the plants and animals which live and die there. And in these marshes, they operate fermentations from which marsh gas or methyl hydride, alcohol and acetic acid result, which I have extracted by distillation.

In the dust of the streets, they come from animal and vegetable detritus of all kinds spread everywhere, but especially from the droppings of horses and other cattle that roam them! In the streets of Montpellier, especially in those boulevards tarmacked with calcareous rocks, and in the roads that lead to them, microzymas are so abundant that this calcareous dust constitutes one of the best lactic and butyric ferments; when diluted in water, these dusts ferment directly and provide alcohol, etc.!

To the microzymas of the present total destruction, we must add the microzymas of the total destruction of the geological ages which come, today, from the natural and incessant degradation of certain rocks in the depths of the earth, which are brought back to the surface by the spring waters; as well as those made free by the trituration of these rocks in their applications to art, industry, agriculture.

Finally, we must not neglect the microzymas that are set free during the incessant desquamation that takes place on the surface of the bodies of all living beings!

**These are the microzymas of all these so diverse origins that the wind disseminates, by billions, at every moment, on the surface of the earth and in the air that surrounds us!**

Associated with these microzymas are the spores of the microscopic flora: algae, fungi, etc., and the microzymas that can come from them. But, as I have already pointed out, the number of these spores is negligible compared to that of the microzymas; as for the eggs of the ciliated infusoria, there is not even any need to worry about them.

It is not without interest to point out to you, from now on, that among these microzymas are necessarily those of all the beings which died of the most diverse pathologies!

The free microzymas of the atmosphere, of the waters, of the earth, are thus coming from animals and plants of all kinds, healthy and sick, dead or alive; coming from the various organic centers of these beings; having already passed to the state of bacteria or not; one conceives after that that there are some of several chemical functions and of unequally apt to evolve into bacteria or to produce cells under varied conditions. **But all of them possess the characteristics of physiological indestructibility, of adaptation to environments, of vital resistance that we have recognized in the most inferior organisms**.

Undoubtedly the microzymas, by passing by various intermediate forms can evolve into bacteria; but it is still necessary to remember that this singular property, the microzymas of the various organic centers, at the various ages, do not possess it to the same degree; what will lead us to recognize that the microzymas, morphologically similar, differentiate themselves with time, by changing function or by acquiring new ones in the various organic centers.…

## Are microzymas plants or animals?

… I have always answered by saying that "Microzymas are plants in plants; animals in animals; since they constitute what is primitively alive in both, … »

… < reflections of Pasteur, Robin, Dumas, Bichat p. 661 à 669 > …

Certainly M. Bichat was right. And this is so, because in animals, as well as in plants, microzymas are, ab ovo, the living units per se, without which the chemical, physiological, histological functions that are manifested in them, would not be. We have recognized it, there are in the animals and in the plants, irreducible organic centers as for the function; now, as many organic centers as many distinct microzymas, not morphologically, but functionally! **In short, the microzymas constitute the links of the two kingdoms. Certainly there is unity of plan and functional differentiation by the microzyma. Theoretically, there is only one living kingdom: and, as in an organized being a new function manifests itself, a new apparatus is constituted by microzymas which acquire new properties**: consideration on which I will insist in the next conference by developing the notion of the change of function in the microzymas, notion of which I have already made you feel the importance.

# 12th conference

Everyone has an idea of what a living being is. But few people have the idea of what the organization is in its essence. We have a vague notion of the thing, without being able to specify which are, in the living organism, the parts "from which the vital action starts", as Mr. Virchow expresses himself. In the same way, we have the idea of health or disease, without being able to define exactly what the one and the other consist in.

…< doctrines of solidism and humorism etc. on the disease p.670 à 677 >…

... We must conclude that it is in something which is not simply chemical matter, but which is organized, living, that we must look for what can become sick, that is to say, what can undergo some modification in its way of being and its function.

Yes, if we were formed only of purely chemical matter, we would be imperishable as well as any matter, because in nature, materially, nothing is created nothing is lost: the substance of a crystal which is destroyed is not annihilated, it can always reform the crystal, identically, individually what it was before. What disappears when the destruction seizes us, it is more than matter, which of indestructible essence, will never reproduce identically the same individual, to whose organism it had been only lent. It is as organized and living individuals that we are the prey of disease and death. But, to be the prey of death, is it not physiologically to be still the prey of life ? since the total destruction, naturally, is only possible thanks to the contribution of what is physiologically and chemically alive in us and which persists after death ! Yes, every organized being is destined to be the prey of life!

…< p. 677 à 679 >…

## Change of function of microzymas

I have insisted on the fact that in the egg the microzymas are endowed with certain determined properties and that they acquire new ones during the embryonic development itself, while they build the cells which proceed to the construction of the principal systems of organization... From this set of facts obviously results the notion of change of function of the microzymas, a notion to which I now want to call your attention in a very special way, because it will make us understand, which is of capital importance in pathology, that the microzyma can become morbid, capable of acting morbidly, of communicating the morbid state which is in it and, what is more serious, of preserving it more or less long.

... in the healthy and living organism, one never notices the bacterial evolution of the microzyma; I say in the organism, that is, in the intimacy of its tissues. ... in the pathological state, we can grasp all the phases of the bacterial evolution of the microzyma.

We already have the experimental notion of the fact of the conservation of the function; we have already acquired it by observing that the microzymas of the pancreas, of the stomach, etc., act, in the free state, exactly in the same way as in the gland. Finally, the oral microzymas that have evolved into bacteria act on starch as they did before evolution! But the function can also be exhausted and lost, without the bacteria or microzyma ceasing to live and manifesting some activity in another sense.

...

But doesn't the whole history of microzymas, such as it results from these conferences, lead us to consider as demonstrated 2 propositions that we can formulate as follows, namely :

"The microzymas, morphologically identical and personally organized ferments, have, in each natural group of beings and for the same organism in each center of activity, something specific that is characterized by the function."

"Since in the organized being everything proceeds from the egg from the point of view of the histological elements, it seems obvious that, in parallel to the anatomical evolution, there is a functional evolution which leads for the pancreas, for example, to the very remarkable properties of these microzymas in the adult."

These 2 propositions should be seen as fundamental; to make them obvious, we will go back for a moment.

It is obvious that the egg and the seed can be studied as the starting point of the organization …

…< reminder of the development of the embryo from microzymas alone (if the development conditions are respected) p.681 – 682 > …

These are the first facts which show us the microzymas changing at first in property and even in function. And as these changes are accomplished in them, the organic centers become more and more constituted, and the new being, from the embryonic state, passes into the fetal state and later little by little becomes adult while all the organic centers acquire the fullness of their function and activity; so that, the functions being all definitely established, the new apparatus will in its turn produce an ovum and an egg which will reproduce the same phenomena under the same conditions and in the same order, so that the circle of organic development is perfect!

Now compare the microzymas of the various centers of organic activity with each other and with those of the egg. The microzymas of the vitellus release oxygen only with extreme slowness; those of the lung, the blood, the liver possess this property to the maximum; it is less in those of the pancreas; less still in those of the nervous glands; nil in those of the gastric glands, of the bone, the periosteum, the cartilage, etc. I will point out some others.

The microzymas of the pancreas are among those which most firmly establish the notion of change of function.

These microzymas do not acquire the fullness of their properties and functions until quite late. Now, since they are in the pancreas from the fetal state and do not possess the activity that they will have later, we can say that there are fetal pancreatic microzymas and that there are adult ones. It is these that I want to talk to you about to complete their history.

Their elementary composition is more or less the same as that of the liver microzymas, only a little less rich in carbon; but while these are white or slightly colored, their centers containing only traces of iron, the pancreatic microzymas are brown, and leave strongly ferruginous ashes at incineration. That this difference in elemental composition explains the differences in properties is possible, but it does not contradict the notion of change of function, since both have the same origin as those of the yolk!

The microzymas of the liver differ from those of the pancreas, functionally, in their action both on starch and on albuminoid materials. This is their least difference; the greatest difference is due to a physiological phenomenon of great importance: the pancreatic microzymas, introduced into the circulatory stream, exert a harmful influence that those of the liver do not possess.

## Microzymas in intravenous injections

Messrs. E. Baltus and J. Béchamp injected dogs with pure pancreatic microzymas, of those which had been used in my experiments; they had been washed with ether to rid them of all traces of fatty matter and again with water, and enjoyed all their digestive power with regard to albuminoid matter. From 5 very concordant experiments, it resulted that death occurs almost immediately when the proportion of microzymas reaches

1 mg per kg of animal. The only lesions observed were congestion of the digestive mucosa mainly, congestion that could go, in some cases, to blood suffusion. One could object that death had occurred, as it happens when purulent bodies are injected into the veins: the cells, leukocytes, etc., by clumping, can produce capillary embolisms in the lung, brain, etc. Therefore, death, instead of being the result of the own influence of pancreatic microzymas, would be due to mechanical effects only.

...

In order to establish that the action of pancreatic microzymas is personal, they performed the same operations under the same conditions, with liver microzymas. These had been isolated in the same way as those of the pancreas, .... However, at the same dose and even a little higher, their injection was perfectly harmless!

Here then are the microzymas of two neighboring glands which, in this new respect, differ prodigiously.

They have however a common origin, since they were primitively in the same egg. However, there they show themselves absolutely formidable, here absolutely harmless.

But here is a counter-test extremely worthy of attention; the pancreatic microzymas, of such a great harmful power, are able to lose it in a very remarkable circumstance.

## Influence of bacterial evolution of pancreatic microzymas on their harmful action in intravenous injections

The pure pancreatic microzymas having digested a certain amount of fibrin, the mixture was left in the oven until nutritive fermentation developed; hydrogen sulphide was given off, products of putrefaction appeared, and the microzymas of the fibrin as well as those of the pancreas evolved into bacteria. The microzymas and bacteria, having been separated and washed, were found to be deprived of their normal transforming power with respect to the albuminoid material. However, this mixture of microzymas and bacteria, injected into the veins, in equal or even higher doses, did not produce any incident.

The hypothesis of a mechanical action to explain the death by normal microzymas must therefore be ruled out. It was not as a foreign body that they were harmful and killed. But, since after the phenomenon of fermentation they ceased both to operate in the digestion of the albuminoid materials and to be harmful, may we not suppose that they acted, in the normal state, precisely in virtue of the force which is in them to produce pancreazymase with the materials of the blood. Let us try to understand this.

## Intravenous injections of albuminoids, gelatin, diastase and pancréazymase

...< expériences p.686 à 688 > ...

I said that the intravenous injections of normal albuminous materials were harmless: yes, within the limits of the quantities used in the experiments by the authors. But if the dose exceeds a certain ratio per kg of animal, death can result from the injection, both with blood serum, casein, and with milk, because, in short, these substances constitute for the animal, foreign matters to its blood which bring about a certain dyscrasia which can only be tolerated within certain limits. The excess of foreign matter that cannot be assimilated is eliminated, and the animal succumbs. Gelatin itself, which is not eliminated through the urine, may not lead to death, when the dose is not too much higher than 0.55g / kg of dog; there is malaise, vomiting, diarrheic stools, but the animal recovers. This is because the animal has a certain power of resistance, of tolerance as the doctors say, which allows its microzymas to adapt, for a while at least, to the environments in which they are found.

Certainly, one must be reserved in the interpretation of the results obtained by experiments of this kind; but the harmful activity, at such a small dose, of diastase and pancreazymase, is certainly due to their particular nature and not to a mechanical cause. Is it not apparent that the morbid and chemical functions, except for intensity, are the same in the pancreatic microzyma, and in the pancreazymase which it secretes, so that it is difficult to distinguish what belongs to the producing agent and what to the product? For my part, I am struck with astonishment when I see 1 mg of pancreatic microzymas per kg of dog bring death, when it takes 15 centigrams, i.e. 150 times more pancreazymase, to produce the same fatal result! Why this difference? Is it not because the microzymas, acting on blood materials, have exerted the activity they manifest in the original gland on the same materials, thus producing a sufficient amount of pancreazymase to bring death?

...

In the meantime, these facts oblige us to recognize that the most serious disorders, even mortal, can be provoked by living organisms, pre-existing in the living organism, where, normally, they accomplish necessary and beneficial chemical and physiological acts, but which introduced in the blood, in a medium which is not intended for them, provoke the dreadful manifestations of the most serious morbid phenomena.

It has now been demonstrated that microzymas can acquire new properties and perform new functions in the very organism that originally contained them, in the egg from which they originated. It is thus understood that microzymas are morphologically identical and functionally different, and that it is possible that microzymas from a given center of activity cannot be introduced with impunity into a living environment that is not intended for them.

And it is also demonstrated that a harmful microzyma can become harmless under certain conditions by changing its function ... And we will have the opportunity to show that it is so in other circumstances, for other microzymas. ...

... And in order to proceed from the known to the unknown, from the simple to the compound, we are going to study a subject which I have already indicated to you by speaking to you, in connection with the formation of zymases, of the ammoniacal fermentation of urea and urine. (See 7th lecture, p.333)

## On the ferments and fermentations of the urine, in the physiological state and in the pathological state

… I will only deal with human urine. The history of urine presupposes an exact knowledge of the entire urinary system, from the renal veins and arteries, the kidneys, the ureters, the bladder, to the urethra and its meatus, as well as that of the function itself....

But from the point of view of the microzyma theory, it is necessary that you have a clear idea of what urine is.

According to all the facts I have cited to you in the course of these lectures, and the doctrine which connects them, the human organism is constituted by an aggregate of anatomical elements arranged in centers of more or less complex activity, in which each group, each cell, each microzyma, lives, feeds, develops, or separates and wears itself out in a particular way. Each group, each cell, each microzyma constitutes as many apparatuses where matter is transformed by a phenomenon comparable to a fermentation. **Each cell, each microzyma, in the general aggregate, has an independent existence, and its own environment. It is in this medium that each cell draws the elements of its nutrition after having prepared them by means of its zymase, as if it were making its own medium with the help of the materials that the blood brings to it**. But the elements that each cell or microzyma absorbs, after having been used, are returned, transformed, to the surrounding environment. But these transformed materials would accumulate around

these cells and microzymas and would hinder their normal functioning, things would happen as for the brewer's yeast in the alcoholic fermentation: at the beginning of such a fermentation, the phenomenon is accomplished with intensity; but alcohol, carbonic acid, etc. accumulating in the mixture, it slows down, although the quantity of glucose to be consumed is always abundant! If we could remove the alcohol and carbonic acid, etc. as they occur, and offer air to the yeast, its operation would be more regular! Well, what we cannot do for yeast, admirable arrangements accomplish in the animal aggregate: the spent products are at once removed, while the blood brings, with new materials to be transformed, the oxygen necessary for the regularity of the function! It is in fact in a constantly oxygenated environment that the cells and the microzymas take the complex organic materials that the blood brings them, and they break them down suddenly or little by little and bring them back, splitting them up or oxidizing them into simpler compounds or even into the state of carbonic acid, water, urea, etc.; that is to say, more and more, into the mineral state.

This is how the chemical acts which are accomplished in the intimacy of the being are reduced to the phenomena of fermentation! That is why the glucogenic substances and the glucose can disappear from the organism otherwise than by a phenomenon of oxidation... As for the albuminoid substances... they undergo there duplications as a result of oxidation which give rise to a crowd of compounds less and less rich in carbon and more and more oxygenated...

…< table of products in carbon equivalent p. 693 >…

… at the same time ... a part of the mineral matter is set free. Whatever the explanation, this is the general phenomenon of de-assimilation. But the de-assimilated products, in a given center of activity, obviously no longer being able to serve as food for the cells and microzymas of the center, or to be transformed by them ..., are taken up by the blood, which carries them to other centers where the simplification is accomplished more and more .... This is how the bile acids, after having undergone a first splitting during the intestinal digestion, are reabsorbed to be used for new reactions, and to be reduced in simpler compounds, less carbonated. It is after all these simplifications that the blood carries away the products definitively unsuitable for the maintenance of any of the anatomical elements of the organism, towards an admirable apparatus which, by an elective filtration, leads them into a reservoir which collects them to reject them outside.

…< description in 4 steps of the urination function defined by Ch. Robin p. 694 > …

Urine is necessarily a very complex mixture, .... Urine also contains the products of the proper function of the kidneys, the adrenal capsules, the bladder mucosa, the prostate, and the urethral canal. Among these products there is one that cannot be considered, strictly speaking, as a product of de-assimilation; it is nefrozymase, which does not exist in the blood and which is probably a product of secretion of the microzymas of the kidneys. Finally, there is the bladder mucus, on which we will dwell.

Of the very complex composition of urine and its history, I want to tell you only what is necessary to explain the causes of its ammoniacal fermentation in the bladder. This will give us the opportunity to show that this internal fermentation is linked to the change of function of the microzymas of the urinary tract, and this will lead us to the study of microzymas that have become morbid.

... The characteristic and most abundant immediate organic principle of urine is urea.

… < history p.696 > …

But the origin of urea in the organism was not explained, and consequently the theory of respiration was missing something. Following a lesson by Küss in which this learned professor showed us the shortcomings of this theory with regard to the fermentation of urea, I undertook the research which led to the solution of the problem. The result was that the albuminoid and gelatinogenous materials, that is, all the plastic

nitrogenous materials of the organism, produce urea when oxidized under the influence of hypermanganate of potash…

… < experience p. 697 > …

When an albuminoid substance is left, as I have done, even for a very long time, in contact with oxygen or air, it does not oxidize appreciably, i.e. very little oxygen is absorbed. It is therefore not oxygen, in its ordinary state, that is the agent of oxidation. In the organism, it is thanks to the special anatomical elements, i.e. the microzymas, that oxygen becomes capable of acting like that of potassium hypermanganate.

…< urea in the chemical sense p.698 – 699 > …

Human urine, in its physiological state, has an acidic reaction...; its odor is special, becoming repulsive, ammoniacal, urine-like only when it is altered.

Urea is the most abundant nitrogenous compound of urine..., to the other numerous nitrogenous bodies that it contains, it is necessary to specify the hippuric acid and the coloring matters.

…< p. 700 – 701 > …

For a long time, authors have believed that urine contains some albuminous material only in the pathological state; this is an error which has been the cause of much confusion. But I have shown that the most normal physiological urine, at all ages, contains an albuminoid substance which is of the order of zymases.

Indeed, human urine fluidizes the starch and saccharifies the starchy material; and if filtered urine, well separated from its mucus, is precipitated by a sufficient quantity of concentrated alcohol, it forms a precipitate which, washed with alcohol and wrung out, dissolves to a great extent in water. The aqueous solution contains the active matter, for although neutral, it acts on the poison like urine itself; this matter I have named nefrozymase, because various considerations, now irrelevant, as I will tell you, have made me admit that it is formed in the kidney. The blood of a general bleeding, venous and arterial blood, consequently, does not contain zymase capable of saccharifying the poison. It is thus while crossing the kidney that the urine is charged with nefrozymase.…

…< Control: dog urine taken from the ureter p. 701 >…

… Nefrozymase does not invert cane sugar.

Nefrozymase has the general properties of albuminoid materials...

The amount of nefrozymase varies greatly even in the most normal physiological state;

… < physiological variations p. 702 > …

But it is in the pathological state that its variations are the most significant. Pregnancy, all things being equal, has the effect of increasing the dose.

...

Independently of the nefrozymase and the materials that accompany it, it contains what is called urine mucus…

…< study by Berzelius p.703 > …

In the mucus of normal urine, the presence of debris from the bladder mucosa has been noted, and that is all; we shall see that there is more.

But before telling you about the microzymas found there, it is necessary to tell you what was known about the cause of ammonia fermentation in urine!

## On ammonia fermentation of urine

From time immemorial it was known that urine putrefies, and Fourcroy had seen that urea was transformed into ammonia carbonate. As for fermentation, it was unknown;

...

Pure urea, dissolved in pure water, is no more spontaneously alterable than the aqueous solution of cane sugar.

The fact that the transformation of urea into ammonia carbonate is due to **the action of a special ferment proceeding from the urine itself**, was demonstrated by M. Jacquemart in the laboratory of M. Dumas, following the views that the illustrious chemist had communicated to him.

... < experience p.704 > ...

The notion that mucus converts to ferment has been retained in science, but with the vague notion of spontaneous alteration.

...< this theory has been replaced by the theory of atmospheric germs p. 705 >...

...< Pasteur's research on putrefaction attributed to airborne germs p. 706 à 708 > ...

Yes, the germs in the air can have their part in the phenomena of putrefaction of the urine, but they are not necessary!

Mr. Pasteur neglected "of course" the mucous deposit of the urine, did not pay attention that the composition of the liquid of miction, necessarily, is extremely variable...

I have observed several times that urine of the same sex or of different sexes, collected under the same conditions, exposed to the air under the same circumstances, on the same day, undergoes the one ammoniacal fermentation, while the other remains acidic and, in appearance at least, has not been altered. With the benefit of this general observation, I will tell you what happens when we study the alterations of urine in the physiological and in the pathological state. ...

## Mucus and microzymas in the urine

...< implementation p. 708 > ...

For the examination of the still wet mucus, it is necessary to use the microscope armed with the combination obj. 7, ocul.1 of Nachet. In the normal and healthy state, whether it is male or female urine, more or less large mucus cells, bladder epithelium or urethra, and sometimes isolated granular nuclei and molecular granulations are found, of which only a few mobile ones can be seen, because they are hampered by the viscosity of the mucus. The amount of this mass of mucus and organized elements is very small .... The quantity normally increases after a certain time, because outside the bladder, i.e. in new conditions, the urine, thanks to the nefrozymase, constitutes an excellent nutritive medium, or as we say, of culture, for the microzymas!

When one wants to study with fruit what happens to the microzymas in the urine, one must proceed as we have always done up to now: urine slightly creosoted or phenicised, at one or two drops per 200 cc, at the exit of the urethra, is examined at 1 or 2 days interval, or more often. One sees then the microzymas appearing under the aspect of 2 spheres joined together, appearing in 8 of figure; then the number of grains increases, and one has straight or sinuous strings of 3, 4 and a greater number of grains: the torulacea of Mr. Pasteur and Mr. Van tieghem; rarely under these conditions, one sees the bacterium appearing. If the urine has not been phenicized, it is necessary to observe more often. The same evolutionary phenomena can be observed: the microzymas gather, while multiplying, under the aspect of a string of grains; then they lengthen, and the bacterium appears. Sometimes it is a kind of small vibrio which precedes the bacteria. I

have often seen all the isolated microzymas disappear and only chains are obtained. ... Finally, if one leaves a urine that has become ammoniacal to itself, a little earlier, a little later, depending on the case, **there comes a time when all the associated microzymas and the bacteria have become isolated microzymas again.**

## Fermentations of physiological urine in contact with air

It has long been observed that some urine does not become ammoniacal on contact with air, and I have observed similar facts on several occasions; since urine remains acidic, it was concluded that it remained unaltered: this was a mistake, **it alters in other ways**, that is all. It was further assumed that urea was decomposed, there was no other transformation in urine; this was another error.

When fermentation is accomplished with or without Mr. Pasteur's torulacea, decomposition takes place in accordance with Mr. Dumas' equation: ... But at the same time that urea is destroyed, another fermentation is accomplished in parallel or consecutively.

...Let me remind you that the urine of men who have submitted to abstinence from fermented liquors, **may contain alcohol and acetic acid**.

…< p. 710 > …

## Fermentation in contact with air

This being so, here is a series of several experiments which I published in 1865 to prove that several forms of bacteria can ferment urine, **without necessarily producing ammonia carbonate**.

…< experiences p. 711 – 712 > …

Also, although no excessive precautions have been taken against airborne germs, we find only the normal forms of evolution of microzymas.

## Fermentation of urine in the presence of creosote

We know that creosote, or phenic acid, moderates the bacterial evolution of microzymas. What would happen if we left the urine to itself after having properly phenicized it? ... 10 days after the last urine collection, the mucus is completely deposited ...

The urine remained frankly acidic and not more colored than at the beginning. It does not give off gas by adding an acid...

The urine, even from the point of view of these products, could be considered unaltered. But what had happened to the microzymas?

The mucus deposit at the beginning of the experiment contained only the normal microzymas, mucus globules and epithelial cells. At the end of the experiment, the microscopic observation shows what we see in the drawing of this figure < p. 714 > which shows that we no longer see isolated microzymas; they have become microzymas in strings of 2, 3 ... and a larger number of grains, representing the torulacea of Mr. Pasteur, which is ultimately only a phase in the evolution of microzyma. As you can see, there are no bacteria. There are almost no more mucus globules; but there are still nuclei of bladder epithelium... crystals of oxalate of lime.

And note that, in spite of the small torulacea which is given as the specific ammoniacal ferment of urea, this one has not been decomposed at all...

## What happens to nefrozymase in putrefied urine

…< experiments on pregnancy urine p.715 à 717 > …

It is therefore undeniable that urine ferments in several ways, and that infusoria can consume the nefrozymase it contains. You must have been struck by the role of creosote which prevents any alteration of the filtered urine, which also prevents the ammoniacal fermentation of the urine, but not the evolution of the microzymas to produce strings .... And notice again that Mr. Pasteur does not show any surprise that his torulacea develops in an acid medium, he who claims to explain by the alkalinity of the medium the appearance of bacteria in the yeast broth mixed with chalk! No, acidity does not prevent the bacterial evolution of microzymas, although to a certain degree, it is an unfavorable condition, and alkalinity favors it.

Let's draw a practical application from the facts about phenic acid.

## Storage of urine to be submitted for analysis

When a doctor, for a diagnosis to be made, needs to analyze a urine, which has been carefully collected, he must always be concerned about its possible fermentation. Whenever the analysis cannot be done immediately ... he will add 2 to 3 drops of pure phenic acid, liquid. And for more precaution, if he does not want to analyze the deposit and examine it microscopically, there will be even more guarantees, if he can filter the urine to be preserved…

## Microzymas of the urine as alcoholic and acetic ferments

…< experiences p. 718 à 722 > …

However, these experiments show that the ammoniacal ferment, torula, microzyma or bacteria is not specific, since it is capable of acting as an acetic, butyric and alcoholic ferment. And these facts prove once more the aptitude of this order of organized beings to adapt to the most diverse environments.

It is not correct either to think that the function of the soluble ferment of urea is confused with that of the organized ferment which produces it; for, certainly, the soluble ferment will never produce alcohol and acetic acid.

## Theory of ammonia fermentation of urea

Mr. Pasteur asserts that urea is fermentable matter with respect to both soluble and organized ferment. Consider carefully the terms he used: "Soluble ferment and organized ferment act in the same way on their fermentable matter, that is, on urea!"

In the physiological theory, the fermentable matter of an organized ferment is an organic substance which can serve as food for it; this matter the ferment assimilates in a certain way, and gives it back, by disassimilation, after having transformed it. Now, one cannot say that a soluble ferment, which is not organized, not living, assimilates and disassimilates. On the other hand, it is not admissible that urea should serve as food for the organized ferment, unless we suppose that these organisms can use carbonic acid and ammonia, or urea itself, to constitute their tissues: but then the equation which follows from the experiment would not be verified as it has been, and the organized ferments would not be beings functioning in the manner of animals!

In the physiological theory, as I have explained it to you, the fermentable matter of an organized ferment is an organic substance which can serve as food for it! Fermentation under these conditions is a phenomenon of nutrition: which supposes assimilation and correlative de-assimilation! ...

...In short, the fermentation of urea is the result of a zymasic action, that is to say purely chemical, and not a physiological act of nutrition taking place in the organized being. The evolving microzymas secrete the zymase which operates the fixation of the elements of the water on the urea, absolutely as the sulfuric acid or the caustic potash determine it, to transform it, as amide, in carbonate of ammonia...

The urinary microzymas in the physiological and healthy state, in the bladder, do not secrete the zymase necessary to fix the elements of water on the urea, and this one comes out unaltered. **But outside the bladder, in the new situation which is made for them, they may change their function and become capable of producing the zymase which is called soluble ferment of urea**. By virtue of the law of adaptation to the environment, they adapt to the circumstances and produce the necessary transforming zymase with the help of the inactive ambient materials. This is why both bladder and air microzymas need more or less time to start fermenting urine: the function has to be acquired, and we have seen that it can be prevented from becoming established in both bladder and air microzymas. But still it is necessary that the favorable conditions for that are joined together. Remember experiment II, on the urine of a young man of 18 years old, which placed in the same conditions as the 3 others, did not ferment ammoniacally, but produced acetic acid and benzoic acid! and the authors noted a great number of cases where the urine remained acidic in contact with the air!

**...From this study will result the proof that normal microzymas in the organism can become morbid, acquiring a transmissible morbidity and being able to keep it, but also losing it**...

## Ferments of pathological urine and their origin

…< explanation urine pathology according to Mr. Gubler p.724 > …

Physicians have noted a number of diseases in which the urine is alkaline as early as the bladder. Alkalescence always coincides with an alteration or lesion, probably correlative, of one of the parts of the urinary tract: kidneys, ureters, bladder or prostate. The urine becomes ammoniacal before urination:

- In severe cases of Bright's disease, where the kidneys are altered in any of their parts;
- In acute nephritis and in chronic nephritis;
- In inflammation of the pelvis and ureters;
- In diseases of the medulla where the functions of the bladder are altered;
- In urine retention where, after a prolonged stay, the urine causes phlegmata of the bladder mucosa;
- In chronic cystitis;
- In some particular cases of diathesis.

However, whenever I have examined such urine, immediately after micturition, I have found in it the microzymas increased and for the most part evolved into strings of grains (the so-called specific torulacea), and even into bacteria, mobile or immobile; sometimes the other forms that I have described in urine that has become ammoniacal outside the bladder are also discovered.… < analyse de différents cas p. 725 > …

… < Pasteur's interpretation, recounting, among other things, the journey of the germ up the urethra to implant itself in the bladder p. 726 – 728 > …

…If, therefore, the germs cannot penetrate through the urethral canal, as it is constant that urine can become ammoniacal in the bladder, in cases where there is no injury to any part of the body, nor injury to the intestinal canal, the cause must be sought elsewhere.

Let us assume that urine normally contains microzymas that can evolve into bacteria and all the forms that precede their complete development. This being the case, we may wonder whether ammonia fermentation in the bladder does not have an internal and natural cause, depending on a functional deviation, morbid or not, of the microzymas, manifesting itself, in the cystic cavity, not only by the fermentation of urea, but by a determined histological evolution!

I repeat that every time I have examined ammoniacal urine, immediately after micturition, I have found microzymas more numerous than in healthy urine, and largely transformed into strings (torulas), bacteria and the other forms that precede these. Now, if the germs in the air are not involved in the phenomenon of cystic ammonia fermentation, if, moreover, bacteria are never found in healthy urine, where only

microzymas exist compared to what is found in putrefied urine, it must be admitted that the microzymas generating the different organized forms found in alkaline urine from the bladder, had changed something, since their chemical function had deviated. I say that these microzymas have become morbid.

…< study of different pathological cases p. 732 à 741 > …

## Conclusions regarding bladder microzymas and urine fermentation

1. Atmospheric germs cannot enter the bladder through the urethral canal: it is anatomically impossible;
2. Assuming that, through the catheterization, fermenting germs enter the bladder, they are not the cause of the ammoniacal fermentation of the urine;
3. Without denying, but affirming the existence of atmospheric microzymas and their ability to evolve into bacteria, it is certain that they are not the immediate cause of ammoniacal fermentation of urine;
4. Bacteria can exist in the urine, from the bladder, without undergoing ammonia fermentation;
5. When the urine becomes ammoniacal in the bladder, the phenomenon is correlative to the lesion or morbid condition of some part of the urinary tract, or to a diathesis condition, etc. ;
6. The fact that the urine may be ammoniacal in the bladder and that this state is correlative of the presence of infusoria (bacteria, bacterias, vibrios, free or stringed microzymas), tends to demonstrate that there is reason to functionally distinguish microzymas in the healthy state from microzymas that have become morbid as a result of some alteration of one of the parts of the urinary tract or of a general condition characterized ;
7. The zymase that ferments urea is the fruit of morbid alteration of the function of microzymas, because any soluble ferment is secreted by something organized, cell or microzyma ;
8. The ferments of ammonia fermentation in urine can ferment sugar and starch;
9. There is an acid fermentation of the urine, and the ferments of this fermentation are similar to those of the ammoniacal fermentation. These ferments also act on starch and cane sugar;
10. The evolution of microzymas in normal urine, and consequently its ammoniacal alteration, can always be prevented by means of phenic acid or creosote;
11. Surgeons can, without fear, operate as in the past with the care of cleanliness that they are accustomed to take. However, the most practical advice, as it follows from these studies, is to operate in a phenique atmosphere and to wash the instruments in slightly creosote or phenique water, as much to annihilate the influence of the ambient microzymas as to prevent the evolution of the microzymas of the patient;
12. Bladder microzymas, like all microzymas, can evolve and become bacteria; **but these bacteria, by regression, can reproduce the microzymas**.
13. Surgeons must be much more concerned about the microzymas of their patients, if they are diathesic, than about the influence of microzymas in the air. It is especially in hospital wards that it is necessary to operate in a creosote atmosphere, because there, more than elsewhere, morbid microzymas can exist.
14. It is right to proclaim that in 1843, M. Dumas was right to place the bladder mucus, which converts into ferment, the next cause of the ammoniacal fermentation of the urine. This was the fruit of a marvellous intuition, for one could not even suspect, at that time, that the organism concealed in the intimacy of its tissues agents as powerful as microzymas.

# 13th conference

## Microzymas and disease

The last lecture suggested the possibility of founding a physiological theory of disease of which the theory of microzyma would be the basis.

In order to achieve this, I will first gather, in the form of propositions, the experimental truths that we have acquired in the course of the previous lectures;

I will then draw from them the main idea which will be the foundation of pathology.

These propositions are as follows:

1. All matter is mineral in essence, because its components are the simple Lavoisian bodies.
2. Organic matter should not be defined by its origin, but by its composition: it is nothing other than a more or less complex combination of carbon.
3. What is called ambient organic matter, in the heterogenist system, is something more than a compound of carbon, and than matter in the chemical sense.
4. There is no spontaneous generation. A mixture, in any proportion, of immediate principles, as numerous as one may wish, and of the necessary mineral matter, all the other conditions which the physiologist and the chemist may bring together as the most favorable being present, cannot itself organize itself and become alive.
5. If what, in the school, is called living matter, not morphologically defined, not structured, endowed only with physico-chemical properties, protoplasma, blastema, were what we say and think, everything in the living organism, organs, tissues, cells, microzymas, would be the fruit of spontaneous generation.
6. What we call germs, in the air, in the water, in the earth, are essentially microzymas.
7. Milk, blood, urine, all tissues contain microzymas.
8. Vibrionians can develop in tissues and humours in any part of an organism, animal or vegetable. Age has some influence on this development.
9. Microzymas are what, by evolution, become bacteria. Microzymas are not germs in the embryological sense, but they are the previous state of the vibrio, the amylobacter, the bacterium, the bacteridium, etc.
10. Microzymas are, personally, what we call ferments.
11. Microzymas are also cell factors.
12. Microzymas are what by which protoplasma, blastema, are endowed with the formative power of the living organism.
13. The microzyma is the living organism per se <in itself>. An organism, ab ovo <from the egg>, is reducible to the microzyma.
14. Some natural productions, some tissues in organisms, are formed only by microzymas.
15. An organism, a tissue, a cell, a vibrio can, by physiological regression, be reduced to microzymas.
16. From the total physiological destruction of an organism, microzymas remain.
17. What we call germs of the air, of the waters, of the earth, are essentially only the microzymas coming from disappeared organs.
18. The microzymas, in their normal environment, remain identical to themselves.
19. Microzymas change their function during the development of the organism: they are functionally different in the different centers of activity, and they keep their acquired activity, when separated from their center.
20. It is not said, and cannot be said, that a chemical compound, or a mixture of such compounds, becomes sick or dies.
21. Only that which is organized and endowed with life is susceptible to disease or death.

22. The microzymas being what is primitively alive in the organized being, in which life persists after death; they are the ones that can become the starting point of disease. Primitively, therefore, disease germs cannot exist in the atmosphere.
23. Microzymas can change functionally, become morbid and transmit acquired morbidity; a morbid microzyma can become healthy again.
24. Therapeutics is the science of finding ways to return morbid microzymas to their normal functional mode.

It is important to remember that the fact is certain, demonstrated, verified: bacteria can appear, multiply, in a hidden part of an animal, without the intervention of an external germ being able to explain their appearance.

... in spite of the confirmations of so many scientists, of Messrs Servel, Nencki and Tiegel, among others, it is in our interest not to take them into account

…< Pasteur broke away from the Hippocratic school and became a reformer of pathology p.747 à 750 > …

However, these etiological systems did not prevail, and doctors, in general, continued to place the cause of our diseases in the organism itself. I have spent a large part of my life in medical schools, and I assure you that none of my teachers or colleagues made this the starting point of their teaching, while not neglecting any piece of information in order to make an informed diagnosis. However, these illustrious physicians knew perfectly well that man and animals could be afflicted by parasitic diseases; but they knew how to distinguish the part that belongs to the parasite and to the organism in the development of the parasitic disease; they did not let themselves be imposed by words and appearances.

… < continued on the interpretations of Pasteur's bad observations and on his vision of the disease p. 751 à 757 > …

…< silkworm diseases Pasteur / Béchamp p. 757 à 765 > …

…< vaccine - Chauveau p. 765 à 767 > …

…< anthrax - Davaine p. 768 > …

## Inoculations de bactéries à des végétaux – Davaine p.769

...To make these inoculations, he borrowed the small bacteria of 0,005 mm, agitated with a very fast movement, more or less similar to the bacterium termo, which can exist in certain vegetable substances reduced in putrilage. He arranged for the inoculated infusoria to be retained in the wound. Here is what Davaine observed:

1. Inoculated with Opuntia cylindrica, Aloe translucens, etc., the small bacteria, he said, "propagated while retaining their primitive characters."
2. "In Aloe variegata they gave rise to filaments that reached up to 0.03 mm and were divided into 2, 3 or 4 segments."
3. "The long filaments (from the previous experiment) inoculated to Aloe spiralis produced infinitely smaller corpuscles, which appeared, at the highest magnifications, as very fine dust."
4. "Finally, these long or short bacteria, inoculated to the plants previously mentioned, took back their primitive characters, namely those of bacterium termo."
5. "These alternate transports on various plants have been operated a great number of times with similar results."

Davaine was quite surprised to reap something other than what he had sown, but instead of wondering whether the inoculated plant is not active in the inoculations, he goes after the classification of bacteria ...

... he is disturbed by the fact that he does not see the bacteria he has inoculated reproducing! It is because he did not know that jelly alone, without any inoculation, was sufficient to make bacteria appear, after thawing, in a plant; it is because he did not know that a bacterium, a vibrio, an amylobacter and other forms are only what a given microzyma can become.

... **In the microzyma theory, the inoculated bacterium does not multiply; but by its introduction into the wound made in the plant, it determines a change of environment at the inoculated point, and it is thanks to this change that the plant's own microzymas evolve into bacteria, each according to its species; but as a result of this change, the foreign bacterium undergoes the law of regression and can become microzyma again to evolve then into another form**.

... In publishing my experiments on the bacteria of frozen plants, I said:

"... the same is true of inoculating animals with bacteria, or of injecting a rotting substance into the blood: in this way a dyscrasia is caused which is favorable to the evolution of the animal's own microzymas into bacteria, and the disorders which are the consequences."

I cannot quote all the inoculation experiments which have been made since Davaine, nor the confirmations, unconscious, it is true, of which the theory of microzyma has been the object, even in pathology, on the part of several observers. But it is necessary to point out that these confirmations have been made under the influence of the common hypothesis that there is nothing primitively structured, endowed with independent vitality in a living organism; and that the authors invariably imagine that the micro-organisms they discover in diseases are parasites whose origin is germs coming from outside, ... in accordance with a common opinion taken over by M. Pasteur! ...

The belief in the primitively morbid germs of the air, water and place, as Hippocrates would have said, has become almost superstitious. Recently (1882) a scientist, Mr. Klebs, described a kitchen device intended to preserve milk from bacterial germs, without suspecting that this liquid is full of them; .... One imagines that the slightest crack is enough for an animal to fall prey to these morbid germs.

I have already disabused you of the idea of primitively morbid germs in the air; but you must be convinced, by certain proofs, based on large-scale experiments, that **all the assertions of the authors are purely imaginary.**

**Air does not normally contain morbid germs**.

In fact, no direct experiment could be produced which established that a germ taken from the air communicated a disease. We have been able to prove that a fermentable material, suitably prepared, entered into fermentation of a desired kind, when exposed to the air. And this is easily understood, if we consider that the germs in the air contain microzymas, the conidia, the spores of an infinity of destroyed organisms. Now, in a given fermentable mixture, only those which are suitable for this mixture develop: the others remain sterile. But the organism which has developed in the mixture which has fermented, we can isolate, study and cultivate; we can make it act on such matter as we please and note the uniqueness or multiplicity of its functions! These are doubtful facts; **has the same work been done for diseases? No, and everything proves that we cannot**.

To demonstrate that a germ of the air is a cause of disease, four things are necessary:

1. Introduce this germ, taken from the earth, into an organism, and find it multiplied there;
2. Isolate it from the sick organism, study it thus isolated, and prove that it is itself or a form of its evolution
3. After isolating it, inoculate it again into the animal, and prove that it multiplies there again by reproducing the same disease;
4. To demonstrate that under its influence the microzymas of the sick organism remained indifferent.

However, none of this has been done; every time that morbid microorganisms have been inoculated to a given animal, they have been taken from an already sick animal, and, as in the case of anthrax, the disease produced has not been the same in sheep and in man.

I will now prove to you that huge wounds can remain in contact with the air with impunity, without its absorbed germs producing diseases analogous to those attributed to them free of charge.

## Healing of a wound

…< A. Guérin's thick dressing did not prevent the development of bacteria in some cases and the wounds healed - Pasteur's way of seeing wounds p.773 à 776 > …

…It is not my intention to expose to you the works of the most learned surgeons on pus, and the theory of its formation. ... but Mr. Pasteur really makes good use of the work of scientists such as Küss, Virchow, Robin, Cohnheim, who have all applied the experimental method to explain its appearance in wounds; whatever the theory, they **all make the pus proceed from the organism itself, without invoking anything foreign**. What is indisputable, however, is that all these scientists have neglected microzymas as they had neglected molecular granulations in general histology. Now, whatever one does, one will always find microzymas in the pus; they may not change form, they may evolve and produce associated microzymas, vibrios or bacteria, and the healing of the wounds will not be any less successful, as is evident from the report of M. Gosselin and of all the surgeons who have been able to observe.

## Pyogenesis

In a remarkable thesis, M. E. Baltus examined all the proposed theories; finally he investigated the role of microzymas in pyogenesis.

Mr. Baltus found first of all that there are constantly in the pus microzymas similar to those which exist in the various humours, and he observed that they were personally ferments. This fact being established, he sought what part they played in the mechanism of pyogenesis. Numerous experiments made on the mesentery and the cornea of the frog led him to reject the theory of Mr. Cohnheim, fruit of an optical error, and to substitute the notion of the microzyma factor of leukocytes. However, clinical observation agrees with experimentation to show that at the beginning of the formation of pus, the microzymas contained in the cells or spread in the intercellular spaces, pack and coat themselves with membranes, which surround them in small islands. These nuclei or globulins serve as a call point for new microzymas that also secrete a membrane around them; finally, the proliferation continues inside the leukocyte thus formed and granulated. And it would be wrong to consider this formula as a simple view of the mind. Whether one examines with attention the inflamed tissues under the experimental conditions of which I have spoken, or whether one limits oneself to the study of the wounds on the surface, particularly in the state of budding, one will easily recognize the phenomenal succession which most observers, Lebert and M. Follin, among others, had already pointed out, but without penetrating its nature, for lack of a guiding idea. And it is very worthy of attention that the dressings made with strongly phenicized water do not suppress the microzymas in the pus, nor most often the associated microzymas and sometimes the bacteria: yet if these microzymas had for starting point the germs of the air, one would not find them in the pus.

...

When there is a purulent infection, it is not the airborne germs that are guilty; but the morbid evolution, always possible, of the microzymas of the operated person's organism, whether they evolve or not.

It is thus demonstrated that huge gaping wounds, such as amputation wounds, can be exposed to the air without danger of death and disease as such: yet it is in these conditions that germs would have a great deal of fun.

…

## Air and water in burns

How often would we not be exposed to the invasion of morbid germs if those of the atmosphere and water were what M. Pasteur thinks? I cannot refrain from reproducing here an observation of burns that I asked Professor Baltus to write down for you.

…< severe burns - Baltus p. 779 >…

Certainly the young child, subject of this observation, was in the most favorable conditions for the invasion of morbid germs; the long duration of the treatment, the extent of the lesion do not allow to invoke the discontinuous morbid panspermia. The poor victim of this terrible accident was very happy to be in the hands of such an educated and devoted doctor! Mr. Pasteur would have invoked the germs of the air to explain the delay of the definitive cicatrization: Mr. Baltus nourished the interior microzymas well, while treating the wound, and the little patient was saved.

## Air and microorganisms from putrid abscesses injected into the bloodstream

Mr. Pasteur complacently invokes an experiment of Mr. Chauveau ... to support his assertion that there are no germs of microorganisms in the economy.

…< experience of Chauveau bistournage coupled with an important injection of pus p.780 and analysis from the perspective of microzyma theory p.781 – 782 >…

## Air and transfusion

It is known that transfusion can be performed by reinjecting defibrinated blood into the veins; however, the blood is beaten in the air; the germs have time to fall in, both during the bleeding of the subject who provides the blood and during the beating of the blood. If therefore the germs in the air were what is believed, this operation would always be dangerous.

Mr. Pasteur considers that the instantaneous contact of the air with a bare portion of the body, the slightest crack, may be sufficient to give death, or at least to allow the introduction of a germ which gives rise to the disease which causes it. Everything contradicts his system, even the disease that he puts at the top of the list of parasitic diseases: scabies. Certainly the acarus, opening a furrow under the skin, digging its burrows, brings with it, under the human epidermis, not only the germs of the air, but all the dirt of the scabies and the germs of the surface of the skin when, during the night, in bed, it passes from the contagious to the contaminated. The scabies sufferer thus realizes, as well as possible, the conditions of the germs imagined by Mr. Pasteur: however, the scabies sufferer remains scabies sufferer until he has been rid of the acarus, and does not contract the diseases of which the famous scientist claims to find the germs in the air.

Here is thus demonstrated, in another way, the general harmlessness of the air, not only during the normal acts of life in society, but also in the case where the interior of the organism is brought into contact with these germs, not only in the most violent surgical traumas, but in the most varied circumstances. And we have found that in these different cases it can happen that the microzymas evolve to give, not only associated microzymas, but bacteria, although precautions are taken against atmospheric germs.

I remind you that it is irrevocably established that a separated part of the animal, tissue or humor, can let bacteria appear in the absolute shelter of the air.

It is now necessary to demonstrate that the microzymas of the living organism, during life, can give rise to the evolutionary phenomena that we have observed in the detached tissues of the animal.

## Evolution of microzymas in the living organism

### The pulmonary tubercle in the Cretaceous state

In the same year we had the opportunity to examine lung tubercles in the Cretaceous state in the lungs of phthisis who had just died. Remembering the teachings of Küss

…< according to Küss: the pulmonary tubercle is the result of the disorganization of a normal histological element p.785-786 > …

Well, we have investigated what the matter of the pulmonary tubercle was formed of in the Cretaceous state, that is, when all the epithelial globule of the alveoli had disappeared.

The cretaceous material was contained in cysts with fibrous walls; it was white, opaque and hard, though friable. Under the microscope (obj. 7, oc. 1, Nachet) one could distinguish a host of mobile molecular granulations, isolated or coupled 2 by 2 (what we call today microbe in 8, microbe in double point, diplococcus), resembling in a remarkable way the microzymas of the chalk; like them they were insoluble in potash to the tenth …

…< detail of the analysis p. 787 > …

The demonstration was complete, and we concluded that these microzymas are the remains of the dead epithelium that had first produced the raw tuber, and then the softened tuber or cretaceous.

So as the epithelium becomes sick and dies, not everything in it dies; what had resisted death in the cell was the microzyma! Once again, the cell is transitory; what is most alive in it, most resistant to death, is the microzyma that formed it.

Let us stop for a moment on this observation to understand its meaning.

The cellular theory which served as his guide, made Küss recognize that the pulmonary tubercle is not a heteromorphic product. It is the result of an excessive proliferation of the globular epithelium of the alveoli. But, he points out: "the tubercle and its varieties, being close to cancer in that it develops in the same organic system, in the same normal clusters of globules, it differs essentially in that, instead of a hypertrophy of the elements with all its consequences, it is only an accumulation of these same elements, followed soon by atrophy, necrosis, and decomposition; but in pneumonia also, there is an accumulation of epithelial globules!" What is the reason for these differences? Why does the pulmonary tubercle in phthisis come to be formed only of microzymas? The explanation can only be given by the change of function of which the microzyma is susceptible and whose morbidity is different in cancer, in pneumonia and in tuberculosis. Indeed, the cell being, by hypothesis, what is alive per se, should not be able to destroy itself; because, what is, by virtue of inertia, must continue to be. In the same way that matter does not organize itself, that which is organized must not destroy itself. Again, every physiological or chemical change needs a cause. In accordance with the data of these lectures, let us try to understand this.

In his learned and delicate analysis, Küss has shown us the epithelial cell invading and filling up the cavity of the pulmonary alveoli; by this, the access to the air in the alveolus is suppressed, there is no longer a right of abode. Now, the cells of the alveolus were destined to live in an environment where the air is constantly renewed: they are thus in an abnormal situation and their microzymas too. Now these, being primitively alive, cannot physiologically destroy themselves; they lived in a renewed air which is refused to them; they will not perish, but changing function, they will devour the substance of their cell and, become free, from one step to another, the very substance of the alveoli; there will thus remain at the end only a

mass of molecular granulations which will enkysate, forming what one called heteromorphic tissue, in which the microzymas will continue to live and to feed.

You can see how the two notions of change of function and change of environment apply to pathology as well as to our laboratory experiments. This very natural and physiological way of understanding a phenomenon which was until then very obscure, will not be accepted any time soon. One will invoke, one already invokes, the germs of the air to explain tuberculosis, since these germs are everywhere present and unceasingly in contact with the pulmonary alveoli, why is not everyone phthisic? Ah! no doubt, and unfortunately, the pulmonary microzymas of the phthisis have undergone some change, have become morbid and inoculable! but the real doctors look for the cause elsewhere!

…< Bacteria in fluid from acute pleurisy terminated by suppuration p.789-790 > …

…< Transformations undergone by the bacteria of the intestinal canal p. 790 à 792 > …

…< From the regression of a mycelium into microzymas p. 793 > …

## Parasitism and disease

…< p .794 à 800 > …

... That there are diseases in which beings are found in infusions has long been beyond question. Yes, certain microscopic lower plants, clearly specified, live and proliferate on or in the substance of animals where they find a suitable ground. The Achorion Schoenleinii produces favus; the Oidium albicans thrush on mucous membranes; it is sometimes found in the interior of rather remote hollow organs. Mentagre, sycosis, ringworm are parasitic diseases caused or accompanied by determined mucedinia. The muscardine of silkworms is produced by Botrytis bassiana, the pebrine by the vibrating corpuscle, which has been recognized as a plant species, a psorospermia. I could multiply the examples of this evil flora: each animal species has its particular enemies. These diseases, like scabies and verminous diseases, are unquestionably parasitic. But from the fact that these facts cannot be contested, does it follow that diseases in which only the evolutionary forms of microzyma are seen are also parasitic?

In all cases of parasitism, the parasite is clearly distinguished; it is described as something which has nothing in common with the organism at whose expense it feeds. In trichinosis, autopsy invariably reveals the trichina in the muscles. The vibrating corpuscle is found in pebrine, in the most serious degree of the disease, in all parts of the silkworm, and even in the egg! Is it the same with the so-called parasitic diseases according to Davaine, M. Pasteur and others?

But real doctors do not make such assertions so easily. They ask themselves if real parasites, including acarus, a tœnia, an ascarid, are the cause or the effect of the disease? Yes, it is necessary to ask whether the economy, in order to allow the parasite to establish itself, has not first undergone some general or local modification which constitutes for the germ of the parasite a favorable terrain for its development; whether, for example, a dilapidated constitution does not create an environment in which the parasite finds the elements for its life?

It is recognized," says Mr. Micé, "that parasitism is the consequence of a sickly state leading to the weakness of the subjects; some serious general change precedes and provokes it. Thus, thrush, ringworm and ringworm are more likely to occur in children or in malnourished adults. ... There is therefore a general state of sickness that precedes it: the parasite completes the exhaustion of the subjects. It is therefore necessary to fight the parasite, while instituting a general treatment."

Yes, this is how true doctors see things; for they know: only that which is organized and endowed with life is susceptible to disease. The organism must suffer for the parasite to be present.

…

# 14ème conférence

## Health and morbidity

... "**Illness is born of us and in us**" is the formula of true medicine.

... "**Only that which is organized and endowed with life is susceptible to disease and death**".

...It is necessary to support boldly as demonstrated things:

1. That the animal organism is not impenetrable to atmospheric microzymas;
2. That bare and extensive surfaces of the human body may be exposed, bathed in ordinary air and water without contracting disease;
3. That, in large surgical operations, the presence in the pus of microzymas in crowds, of microzymas evolved or associated in 8, in vibrios or bacteria, is not harmful;
4. That probes can be introduced into the bladder, without particular care for several years, without making the urine amoniacal, although as a result of a violent trauma, the bladder microzymas have evolved to produce associated microzymas, torulas, bacteria ;
5. That microzymas of a given part of an organism, even during the life, can evolve to become vibrionian, without being morbid there;
6. That in the diseased organism, microzymas, by a new change of function, can become morbid; but that microzymas being morphologically identical in the various centers of activity, and functionally different from morbid microzymas, will be able to appear in various centers without being micrographically distinguishable;
7. That morbid microzymas, by virtue of the conservation of the acquired function, can be found in a determined place of the atmosphere, of the waters or of the earth, in the dejecta or in the remains of the being that produced them;
8. And as a consequence, since, in the first place, disease germs cannot exist in the air we breathe, in the water we drink, in the food we eat, these germs necessarily come from an organism that is ill with an acquired disease.

... Yes, every morbid microzyma is a microzyma which has usually belonged to a healthy organism, but which has become ill, I do not say spontaneously, but ill from a disease born in it under the influence of various causes which determine a functional change in the microzymas of a given center of activity. It is in this provoked change that the notion of morbid spontaneity consists.

And these propositions, which must be considered as the consequence and the complement of those which I recalled at the beginning of the last lecture, constitute, in my opinion, the true basis of pathology.

The medical doctrine which follows from the theory of microzyma has been confirmed, since we formulated it, Mr. Estor and I, at the beginning of our research, by several observers in France and abroad. Since that time, a great number of experiments confirm indeed:

1. That what we call disease germs, under various names, are only microzymas or the organized products of their evolution;
2. That these microzymas exist primitively in the cells of the sick organism, and that they are endowed with morbidity in the cell itself;
3. That those which are free in the tissues, in pustules, phlegmons, cysts, etc., come from the melting of the cells;
4. That the morbid microzymas of a given morbidity, belong rather to this group of cells or tissues, than to another;
5. That the morbid microzyma can enter the body through the respiratory and gastrointestinal surfaces;
6. That morbid microzymas can be grown just like normal microzymas;

7. That the microzymas of 2 more or less similar animal species are not necessarily identical, neither generally, nor in the various centers of activity of their organism;
8. That morbid microzymas or the products of their evolution, by a new change of function, can cease to be harmful, either spontaneously, or in determined experimental circumstances.

…< p. 806 > …

What in medicine is called constitution, complexion, temperament, are states of the organism which necessarily derive from the properties of the microzymas, since a cell, a tissue are what their microzymas make them, ...

A physiologically healthy organism is the one whose microzymas, in all centers of activity, are most in conformity with an ideal type, having undergone no morbid change, nor any extra-physiological influence.

It is because the microzymas of neighboring species, and even more so of distant species, are functionally different in certain organic centers, that each animal, according to its present physiological state, has its own diseases, and that certain diseases are not transmissible from one species to another, and often to individuals of different races. What am I saying, childhood, middle age, old age, the sexes have their share of influence in morbid receptivity.

...

There are degrees in the morbidity of the microzymas of a given center of activity, and this morbidity may be exerted only at one point of the organism, in that center of activity. The morbid microzyma is not only that of this or that infectious, virulent, contagious disease, etc. Morbidity consists in any functional deviation of the microzyma, either that its histogenic activity increases as in hypertrophy, or that it remains stationary, or that it decreases as in atrophy.

Now, a morbid microzyma, of whatever order, has not ceased to be endowed with chemical activity. Morbidity is an added property, dependent, no doubt, on some material change; ...

The morbid microzyma, as well as the normal microzyma, can possess a double activity that I have defined: the zymatic activity, outside of it, and the activity of fermentation, within it. Both of them are exercised, simultaneously or successively, in the organism: in the state of health, according to the normal mode, and in the state of disease, according to the abnormal mode. In the physiological state, the products of their activity are weighted and such that they are useful to the whole organism; in the pathological state, they constitute the blood in a dyscrasic state, and this one brings, more or less, in all the centers of organic activity, a correlative dyscrasic state, which creates, for the anatomical elements and, consequently, for the microzymas, new conditions of existence. Now you know how sensitive microzymas are to the variations of composition of the environments: the very forms which are the fruit of their evolution undergo the consequences. Undoubtedly, they are endowed with a great faculty of adaptation to the environments; but they do not suffer any less from it; and this malaise is translated by a functional disorder, depending on the other centers of activity; it can reverberate even on the functioning of the microzymas of the nervous centers, from where the various phenomenal manifestations of the diseases: fever, eruptions, etc.

Naturally, an organism should not become ill, since there are no morbid microzymas in it, in the air, etc. But, as a result of various influences, depending on the environment (not infected) and on individual causes, a state of physiological misery can be created which constitutes a general dyscrasia from which results, for the microzymas, an abnormal situation which, prolonged, can have as a consequence the morbid state and the most serious situation that can be imagined.

…< scrofulous case p. 809 > …

… there are many cases where an insignificant cause becomes the starting point of dyscrasia …

…< histological alterations in the kidneys p. 810 > …

... there are many cases where dyscrasia can be produced naturally, even without trauma...

…< Serous cases: hydrothorax, ascites, hydrocele p. 810 > …

…

In the physiological state, the microzyma may be so small or transparent that it is not visible, or mistaken for a fatty granulation. This is what I have been saying all along. Several authors, among others Messrs. Balzer and Fournier, were quite surprised to find microbes in the liver, to see them insoluble in the solvents of fatty substances, and colorable by certain reagents: naturally, they took them for parasites of the diseases they observed. In blood, it is possible not to see them if one does not use some artifice: Mr. Pasteur did not know how to see them. It is because their transparency is the same as that of the medium; but remember what I told you about the crystalline lens: it is of an absolute transparency, however it is almost formed only of tubes and microzymas. The morbid evolution of the microzyma, especially when it is accompanied by some morphological change, communicates to it the property of being easily visible by a variation of refringence...In the diseases of silkworms, notably in the eggs of the dead flats, I often saw some whose smallness was such that they certainly measured less than 0.0001mm; so much so that Mr. Pasteur, in spite of my having pointed them out to him, declared that he did not see them. But since then he has learned to recognize them, as well as other scientists: but they persist in seeing only parasites...

I will now review the observations and research of which some diseases have been the object. The consequences of the theory will be evident. One of these researches is contemporary to those I have made on the diseases of the silkworm; it is of exceptional importance, because it is purely medical and made without preconceived ideas; we will find in it the demonstration of almost all the propositions I have formulated at the beginning. It concerns phthisis and tuberculosis in general.

## Tuberculosis and the inoculability of tuberculosis microzymas

… < p. 812 à 814 > …

Let us conclude, therefore, that the free tubercular microzyma comes from the pathological destruction of an epithelial globule, or cell, of certain tissues; that it is the ferment and that it is cultivable, being able to multiply in appropriate media. It does not pre-exist originally in the air, it is the product of the sick organism. Phthisis, tuberculosis, is not a parasitic disease. No, no, there is no microzyma created to make people and animals phthisic. In spite of Mr. Pasteur and his followers, doctors will continue to look at phthisis as developed by other causes than a parasite: habitual stay in a place where the air is not sufficiently renewed, untimely temperature variations, habitual humidity, insufficient nutrition, poor quality food and, above all, misbehavior and certain vices, or cohabitation with phthisics.

And now apply the notion that the cell is a transient anatomical element, and this other, that a microzyma is liable to become morbid, and you will recognize that the microzymas of tuberculosis are only the ultimate term of the regression of a cell or group of cells, but microzymas that have become morbid. **When this microzyma is inoculated, it does not multiply**, but it produces a dyscrasia which modifies the conditions of existence of certain groups of cells, from which results their regression, with morbid evolution of their microzymas.

## Ordinary pus and virulent pus

… < p. 815 à 816 > …

From the point of view of the microzyma theory, the study of pus would be worthwhile to be taken up again; indeed, since it has been shown that the microzymas are not identically the same in the various centers of activity, it is easy to understand that the changes they undergo in suppuration are not identically the same either.

The pus is characterized by the presence of white blood cells similar to the leukocytes of the blood, so similar, micro-graphically, that it has been claimed that the former are merely the latter which have emerged, by diapedesis, from the capillaries. It necessarily varies according to the nature of the diseased organ, the degree and nature of the inflammation, the character of the wound, and the time of suppuration. Authors have paid much attention to the shape of the leukocytes in the pus, to the qualities of the pus, to the disappearance of the globules, but before my research, no attention was paid to the microzymas, neither of the normal pus nor of the virulent pus.

You have seen that M. Chauveau, applying the theory of microzyma, demonstrated that virulent pus owes its virulence to the free microzymas it contains, and, moreover, as he noted later, that this virulence is possessed before the cell that contains them is, by regression, reduced to its microzymas.

Suppuration can be caused either by a trauma or by an internal cause: in either case, the cells of the tissue are placed in an abnormal situation, which determines an exaggerated proliferation and then, as we have seen in connection with the pulmonary tubercle, the death of the cell by its regression to microzymas.

A first point is thus acquired: pus is or is not virulent, and there is no essential histological difference between the leukocytes of pus of such or such origin; the presence of such or such vibrionian, free or associated microzyma in 8 digit, means nothing. Hence it follows that the virulence, of this or that nature, can only be attributed to a morbid change occurring in the microzymas of the subject.

In general it is in a pustule that the virulence of the pus occurs. …

… < p. 818> …

It is in these foci of this kind that virulent pus develops. Cellular proliferation is followed by regression; the cells become deformed, and soon, as in any species of pus, the microzymas swarm, evolving or not evolving; the morbid dyscrasia ... is concentrated in the microzyma which has acquired a new function. Now the function, acquired under the influence of the morbid state, is in a close relationship with the animal species that has become ill. It is therefore to physiology as much as to histology and chemistry that one must resort to shed light on the pathogenesis of virulence. It is on the basis of these observations that I will now show you that, in all the experiments attempted in recent years, it is the microzyma, specific to an animal species, and not a germ of the air, which has been found to be the seat of virulence. It has never been possible to produce, with germs taken from the atmosphere, the diseases that are said to be parasitic; whenever, by inoculation, it has been possible to reproduce a known typical disease, it has been necessary to take the so-called parasite from a sick animal; just as in order to inoculate tuberculosis, a tubercle has been taken from a subject who had been primitively or secondarily affected by it.

The syphilitic virus … p.819

Sheep pox and its microzymas … p.820

Virulence of cells and microzymas of acute glanders … p.823

Smallpox and vaccinia … p. 824

Rinderpest … p. 826

Symptomatic charcoal … p. 827

Spirillum of recurrent fever, or relapsing typhus fever … p.829

Malaria fevers and their parasites … p.830

Typhoid fever … p. 831

Sepsis … p.833

Spleen blood or anthrax … p. 836

Puerperal fever … p. 851

Asian cholera … p. 852

Chickens' cholera … p. 853

Erysipelas - Diphtheria - Scarlet fever - Rheumatic diseases - Measles … p. 854

Rabies … p. 855

The theory of reinforcement of M. Pasteur … p. 856

Theory of preventive inoculations … p. 858

I have faithfully stated the works and opinions of the authors. **The works prove in their own way that what is considered to be a parasite comes from the sick organism, is the effect of the disease, far from being the cause of it**….

## The microzyma theory and the parasite system p. 865

What is most lacking in the parasitic system of diseases is an experimental basis; in fact, it is based on a preconceived opinion. It has not been demonstrated that a specific microbe of this or that determined disease exists primitively in the air. It has been sought, but in vain. The system is flawed at its core.

The fact is undeniable: yes, there are microscopic organisms, from the microzyma to the most developed bacterium that derives from it by evolution, that are capable of communicating diseases. To deny this is to deny the evidence. But they are found in the air, in the water, in the soil only accidentally, and then we know where they come from. ... In fact, when it was possible, with a microbe from the earth, to give blood from a spleen, we were obliged to go and find it in the one where the corpse of an animal, which had died of anthrax, had been buried. This fact, considered in itself, firmly establishes the notion of morbid spontaneity, not spontaneity without a cause, mind you, but physiological spontaneity caused...

In the first place, from the total destruction of a corpse or of any part removed from the body during life, there remain at the end only microzymas, which from the earth go disseminating in the air, in the waters, and the morbid microzymas remain mixed with the others. Now, and this is certainly providential and, consequently, marvelous, this total destruction is the result of what we call fermentation, putrefaction, accompanied or followed by oxidation phenomena; the consequence of this fact, as you have seen, is the disappearance without return of the virulence in the microzyma, in the vibrio and in the bacterium, whether they regress or not; it is the same phenomenon that allows to introduce without danger, in the blood, the pancreatic microzyma after it has operated the putrefaction of the albuminoids that it has first transformed So, generally, normally, there can be no morbid microzymas in the air; it is only exceptionally, accidentally that they can be found there.

In the second place, it must be repeated, it has never been possible to demonstrate that such and such a disease, spleen blood for example, was produced by a germ taken from any point of the external atmosphere...

In the third place, once again, it has not been proved that it is the inoculated microbe that really multiplies...

... < p. 869 à 875 > ...

## Natural or induced dyscrasias

I have several times invoked dyscrasia to explain some of the facts of the parasitists. .... I remind you that the microzymas change function, undergoing a kind of maturation, from the ovum, fertilization, embryonic and fetal development until the age when the being can reproduce; that they are endowed with properties, charged with various functions in the different centers of organic activity and capable, in the tissues of the animal, or removed from the animal, in the tissue itself and in various culture media, of evolving to become one of the forms of bacterial evolution; finally, that we can act on them to prevent them from evolving, and on the cells to stop their destruction by regression.

And the influences which we can thus bring to bear, though apparently small, are nevertheless of considerable effect. Yes, a very slight change, in the environment where a microzyma and a cell live, is often enough to modify their way of being, to the point that the cell is destroyed or preserved, a microzyma evolves or does not evolve, produces or does not produce a cell.

...

The fluids within which our cells and tissues live and function in the normal, natural state are ... "crass". After death, the environment quickly becomes dyscrasic; the cell is destroyed and bacteria appear.

And, notice, as the yeast modifies its environment through fermentation, its functioning is more or less impaired. This is because the products of de-assimilation that remain in the surrounding liquid constitute it in a dyscrasic state for the yeast.

It is no different for each of the anatomical elements of our tissues. They are placed and function in media (Bichat's fluids) which, by admirable arrangements naturally made, preserve a substantially constant composition; they vary unceasingly, no doubt, but unceasingly they are brought back to the same type of composition. This state of constant composition is what in medicine is called the crase of the humours and blood. **Dyscrasia is the deviation from the physiological state in the composition of the humours, either by increase or decrease of some essential component, or by addition of a foreign element**. ...

Overwork as a cause of morbid evolution … p. 878

Freezing as a cause of dyscrasia … p. 879

The influence of the nervous system … p. 880

...**But it would be wrong to imagine that the morbid microzyma, evolved into a bacterium or not, which has reached a healthy organism, multiplies there**, as the parasitists affirm, to make it sick. It merely creates a dyscrasia which leads to the morbid evolution, corresponding to its own morbidity, of the microzymas or of a group of microzymas of the affected organism. I say corresponding, and I am wrong, because the provoked disease can be very different: it depends on the animal species on which the inoculation is made.

Spontaneous disease is therefore that which occurs naturally under the influence of various provocative causes, but without the assistance of a morbid microzyma or of an external cause of another order, directly harmful, as would be a poison, a trauma, etc.

The very diseases which are characterized by real parasites or by certain lesions, do not have these parasites or these lesions as their primary causes. Cl. Bernard formally recognized this: "In a great number of cases, the anatomical lesions are the effects of the morbid state, instead of being the latent causes which gave rise to it."

The same scientist recalled that frogs, long held in captivity, whose health is weakening ... in this case they succumb to parasitic affections with the greatest facility ... "Now if, in a jar containing frogs already invaded by the parasite (microscopic fungus ...), you introduce a perfectly healthy frog, it will not suffer the effects of contagion; but a frog already sick bearing ulcerations, will be immediately affected by the parasite." In short, the disease had prepared the ground for the development of the parasite; the latter aggravates the situation in two ways:

- By appropriating the substances elaborated by the animal for its own benefit and
- By producing by its own transforming activity a dyscrasia which is added to the one that the disease had produced.... une nouvelle morbidité en est la conséquence ...

*Only that which is organized and endowed with life is susceptible to disease* < Bichat >. This proposition is worth repeating at this time. The parasitist who imagines that a parasite called a microbe is primitively the cause of disease, is obliged to tell us to what it communicates the disease, to what it is an unnatural exciter...

**Normally, microzymas, which have become free by the regression of cells or the dissociation of a tissue, are not morbid; they are healthy like the cell itself**. The microzymas of one gland can be morbid without those of another gland being morbid. When medicine localizes a disease, one can, almost certainly, predict that a corresponding tissue alteration will occur, more or less rapidly, with the duration and progress of the disease. Thus, we see free or more or less evolved microzymas in diseases of the liver, kidneys, blood, spleen, skin, bladder mucosa, etc. These microzymas are invariably mistaken for parasites, and they may sometimes not even be morbid. The physiological functional specificity of microzymas in homologous tissues and cells explains the corresponding morbid specificity: it explains it so well that, according to the observations of M. Duboué, it is the microzymas of the nerve centers which become rabid. In an apoplectic scar of the brain, M. Virchow has observed, in discolored red blood cells, the presence of granulations. A parasitist, like Mr. Pasteur, would have regarded these granulations as parasites having invaded the globules. What do I say, they really looked at these free or more or less evolved microzymas as being parasites, saying that they have penetrated from the outside into the cell, into a tissue, into the blood, to destroy them!

But, I repeat, under no circumstances has direct proof been provided that any of the diseases that parasitists claim to be parasitic was determined by a parasite having spontaneously penetrated from the outside into the body of the sick animal. Even when they directly inoculate an isolated or more or less evolved microzyma, they have never shown that it is the inoculated object that multiplies in the body and invades it in colonies, as they say... < p. 883 > ...

## Application of the concept of natural and induced dyscrasias to morbid spontaneity...

... < case of subcutaneous surgeries p. 884 > ...

... < epidemics of typhoid fever, smallpox, cholera in the trenches p. 884 à 887 > ...

## The real causes of our diseases

... **We should only die of old age**.

There have been, there are energetic wills that know how to resist the degrading passions of our species; these noble and beautiful natures give birth to races that are healthy in body and mind, that resist the causes of disease and that only die of old age. Alas! there are too many whose faltering wills falter, who let themselves be led by their inclinations and succumb....

Anatomical analysis would not reveal anything particularly characteristic in these dilapidated organisms; it would find the cells with their ordinary form; physico-chemically they are formed of the same matter as the physiologically healthy ones. Their functions are carried out normally, at least in appearance. Doctors, however, know how to recognize them. In them a dyscrasia can quickly be produced, because their microzymas, overworked to excess, easily tend to change function at this or that point of the economy; the dyscrasia becoming generalized, the morbid evolution of another category of microzymas can be the consequence, and the first case of an epidemic is created, without there having been any harmful microbe around...

## Virulence in the parasite system and in the microzyma theory

**The opposition between the parasitic system and the theory of microzyma is so absolute, that the former believing the cause of our diseases to be outside of us, the latter asserts that it is within us, and primitively only within us**.... The fact being demonstrated, as I believe, the system of the parasitists is ruined at the base: there are no specific microbes created for such and such a disease; there are only accidentally, in the air, etc., microzymas that have become morbid in a physiologically constituted organism that becomes sick by a physiological modification of its way of being...

According to Pasteur, a non-virulent microbe can become virulent by passing through several organisms of the same species: it is thus this organism which produces the virulence. In the hypothesis, is this indeed parasitism? But what is virulence? We don't know! Sometimes it is a narcotic; sometimes it is a struggle for existence, between the bacterium and the blood cell which compete for oxygen; between the microbe and the anatomical elements, the latter diverting to its profit certain nutritive materials of the fluids of the economy .... As for the question of knowing why such a microbe virulent for a species and in this species for a race, is not for another species or a race, the system imagines other hypotheses just as fanciful.

The theory of microzyma does not know either what virulence consists of, that is certain; but it has indicated the path that must be followed to discover it. For this research, it has a solid basis in the notion of change of function; it can provide the peremptory proof that this change is physiologically determined...

… < reminder about pancreatic microzyma becoming harmful when injected into the bloodstream p.891 >
… But the pancreatic microzyma, ..., can lose what can be called its septicity: it is enough that it is made to putrefy the materials of the fibrin that it has digested; and this makes us understand that, in certain physiological conditions, **a morbid microzyma can cease being so**…

## Parasite system, healing and preventive inoculations

... What happens to the bacteria that invades the sick animal by billions, when the disease ends with the cure? ... What happens to the parasite in the inoculations intended to provide immunity?

… < p. 893 > …

The theory of microzyma is able to explain all the difficulties. Indeed, the microzyma is nothing other than the organized substance itself; it is what makes each parcel of the organism alive: it is what makes the egg and all its becoming. The (experimental) notion of change of function explains how it can become morbid and carry away the acquired morbidity; the same notion accounts for the loss of morbidity. The microzyma does not leave the organism, because it is its very living substance, during health as well as during disease: healing is therefore easily conceived. Heredity also: it is the tubercular, scrofulous, syphilitic microzyma, etc. During all the time of the embryonic evolution, the histological faculties predominate in the microzymas; the morbidity, because of the speciality of the environment, is there, if not attenuated, at least momentarily masked. It is even possible during this time and during the young age, by dint of appropriate care and treatment, to bring the microzymas to lose their morbidity, to return to the normal mode and thus

to procure the cure. If this is not the case, the disease may break out with intensity at the slightest opportunity.

...

In the theory of microzyma, it is not the vaccinal or smallpox microzyma that multiplies to produce the disease, as I explained to you when I spoke of Mr. Chauveau's experiments on vaccinations by the pulmonary or gastrointestinal route; but a dyscrasia occurs under their influence that determines a change, more or less lasting, in the homologous microzymas of the organism, which prevents them from undergoing a new evolution, and which provides immunity. It is because the microzymas become morbid of a given morbidity, are modified in a certain way that has little or no influence on their essential physiological and chemical properties, that the disease that heals does not recur. Preventive or preservative inoculation brings about a similar modification by a dyscrasia of the same order, without one being able to say, for example, that there is identity between the vaccinal or smallpox microzyma…

…< remote consequences of arm-to-arm vaccinations p. 897 à 899 > …

## The consequences of vaccinations

… Some observations concerning the hen cholera microbe do not let me but worry for the future of the preventive inoculations of Mr. Pasteur. No, this scientist does not know anything else about attenuated bacteria, except that they are still inoculable and provide immunity! But what about the distant aftermath? Parasitists seem to me to act like empiricists, and when I say that they do not know what they are doing, I have the right to say it; for they neglect the proper, independent, physiologically indestructible and modifiable vitality of the organism's microzymas. They do not even know what happens to their so-called microbes during the process that provides immunity...

We imagine that we are inoculating microzymas with a certain morbidity and we are inoculating the unknown.

**Ah, let's not imitate Prussia, let's not impose the obligation to vaccinate**. Read in Gintrac the adventure of Dr. Hubner, who communicated syphilis with the vaccine! I know that all the young subjects vaccinated by Dr. Hubner did not show the symptom of constitutional syphilis, but that 8 of them were affected by it and that they communicated it to 9 adults! Isn't this appalling? It has been observed that children from another locality, vaccinated with the same virus, were free from any other contagion: but this only proves one thing, that everything does not depend on the vaccine, but especially on the microzymas, that is to say on the diathesis state, of the vaccinated people, to whom the vaccination imparts or does not imprint a given morbid evolution.

...Everything is dangerous in these kinds of experiments, because one does not act on something inert, but because one modifies in a certain way, more or less harmful, the microzymas of the inoculated. …

## Agreement of the microzyma theory with real medicine

… A pathological theory based on that of microzyma would be able to satisfy the philosophical physicians who are almost all attached to the doctrine of Hippocrates. This learned medicine, in fact, which knows so well how to take into account all the circumstances that can alter health: places, airs, waters, foods, the whole of the hygienic conditions of life, medical constitutions; which studies the sick subject in himself as a whole which reacts, tends to its conservation, is susceptible to be affected by purely moral influences ; which affirms that the primary cause of illness is within us and that if external influences have some part in the production of the affection, it is only because they put this cause into action by producing some modification in the living being; yes, this medicine, which has a clear idea of all this because it has deduced

it from the observation of healthy and sick man, which has the idea of diathesis and illness without resorting to a producing microbe, is the true medicine

… < therapeutics and microzyma theory p.904 à 920 > …

… < general conclusions p. 920 à 926 > …