CHAPTER XI

Nature's Experiments

We have taken a cursory peep at Béchamp's arduous toil in his laboratory; but he himself would have been the first to insist upon the greater importance he attached to experiments directly undertaken by Nature. To these he gave incessant study. Whenever possible he would visit the hospital wards and make a close examination of the cases. He carefully followed the medical work of Professor Estor and of the many other doctors with whom he was associated at Montpellier.

A cyst, which required to be excised from a liver, provided a wonderful demonstration of the doctrine of bacterial evolution, for there were found in it microzymas in all stages of development, isolated, associated, elongated; in short, true bacteria. Dr. Lionville, one of Béchamp's medical pupils, had his interest greatly aroused and demonstrated that the contents of a blister include microzymas and that these evolve into bacteria.

With extraordinary patience and industry Professor Béchamp and his colleagues continued their medical researches, finding the microzymas in all healthy tissues, and microzymas and many forms of bacteria in various phases of development in diseased tissues. Punctuating his clinical study by laboratory tests the Professor instituted many experiments, which space forbids our enumerating, to prove that the bacterial appearances were not due to external invasions.

[1]One day an accident provided an interesting contribution to the observations. A patient was brought to the hospital of the Medical University of Montpellier suffering from the effects of an excessively violent blow upon the elbow. There was a compound comminuted fracture of the articular joints of the forepart of the arm; the elbow was largely open. Amputation was imperative and was performed between seven and eight hours after the accident. Immediately the amputated arm was carried to Dr. Estor's laboratory, where he and Dr. Béchamp examined it. The forearm presented a dry black surface. Complete insensibility had set in before the operation. All the

[1] *Les Microzymas, par A. Béchamp*, p. 181.

symptoms of gangrene were present. Under a high power of the microscope, microzymas were seen associated and in chaplets, but no actual bacteria. These were merely in process of formation. The changes brought about by the injury had progressed too rapidly to give them time to develop. This evidence against bacteria as the origin of the mortification was so convincing that Professor Estor at once exclaimed: "Bacteria cannot be the cause of gangrene; they are the effects of it."

Here was the outstanding difference between the microzymian theory and its microbian version, which Pasteur and his followers were to be instrumental in promulgating. Pasteur seems to have lacked an understanding of the basic elements of living matter. In life he compared the body to a barrel of beer or a cask of wine.[1] To him it only appeared an inert collection of chemical compounds; and therefore naturally after death he recognised nothing living in it. Consequently, when life incontrovertibly appeared he could only account for it by the invasion from without of those minute air-borne organisms, whose reality Béchamp had taught him to understand. But the explanation of their origin from the cells and tissues of plant and animal forms took him considerably longer to fathom, though, as we shall see, he eventually actually made an unsuccessful attempt to plagiarise Béchamp's point of view.

Béchamp and Estor, meanwhile, steadily persevered with their clinical observations and made a special study, for instance, of microzymian development in cases of pulmonary tuberculosis. The effects they saw in their medical work they proved and tested by laboratory experiments, and with the intense caution of true scientists they carried out almost innumerable tests to substantiate, for example, their belief in the development of bacteria from microzymas, and the fact that an invasion from without of those at large in the atmosphere is not required to explain their appearance in internal organs.

It was, however, one of Nature's direct experiments, a chance demonstration in the vegetable world, that offered Professor Béchamp one of his best proofs of inner bacterial development, apart from atmospheric interference.

As we have said, the climate of Montpellier is almost subtropical for the greater part of the year, and various sun-lovers among plants may be found growing there, including eccentric-looking cacti, with their tough surfaces and formidable prickles.

[1] See p. 73.

During the winter of 1867 and 1868, however, severe cold set in, and hard frost took liberties with the cacti to which they were quite unaccustomed.[1] On one of these cold winter days, Professor Béchamp's sharp eyes, which never missed anything of importance, noticed an Echinocactus, one of the largest and sturdiest of its kind, frozen for two feet of its massive length. After the thaw set in, the Professor carried off the plant to examine it. In spite of the frost-bite, its surface was so thick and hard that it was absolutely unbroken. The epidermis was as resistant as it had been before the misadventure, and the great density of the tissues safeguarded the interior against any extraneous invasion apart from the intracellular spaces connected with the outer air through the stomata. Yet when the Professor made an incision in the frozen part he found bacteria teeming inside, the species that he called *bacterium termo* and *putridinis* predominating.

Béchamp at once realised that Nature was carrying out remarkable tests of her workings, and when frost set in again on the 25th January and lasted until the end of the same month he determined to verify his preceding observation. The interesting plants in the Botanical Gardens provided him with fine opportunities, for many of them became frozen.

He started his observations with a cactus named *Opuntia Vulgaris*. This was only frozen in part, and on scraping the surface with a scalpel the Professor convinced himself that it was entirely unbroken. In his own words, not the minutest cleft had been formed by which an enemy could find access. Yet, all the same, under the skin and down to the deepest layers of the frozen part lurked tiny and very active bacteria, and also larger bacteria, equally mobile, of a length of 0.02 mm. to 0.04 mm., though these were less numerous. The normal microzymas had completely given place to bacteria in the frozen parts. On the contrary, it was noteworthy that in the healthy parts, untouched by frost, there were only perfect cells to be found and normal microzymas.

Béchamp next examined a plant known botanically as the *Calla Œthiopica*. This was frozen down to the ground and so perished that the slightest touch made it crumble to powder. Microscopic study showed microzymas in the course of transformation into excessively small mobile bacteria; there were also large bacteria to be seen, measuring 0.03 mm. to 0.05 mm. Nature had also provided a valuable control experiment, for, in

[1] *Les Microzymas, par A. Béchamp*, p. 141.

the centre of the decayed frozen plant, a bunch of young leaves was left green and healthy, and here only normal microzymas were to be found, in striking contrast to the transformation scenes taking place in the surrounding parts, which the frost had shattered so ruthlessly.

A third illustration was provided by a *Mexican Agave*. In the unfrozen part only normal microzymas were to be found, while in the blackened and frozen portion of the leaf there was a cloud of very mobile microzymas, and there also swarmed bacteria resembling the *bacterium termo*, and in small quantities bacteria that measured from 0.01 mm. to 0.03 mm.

In another *Mexican Agave* the blackened and frozen part of the leaf did not contain any microzymas, but only small bacteria and some longer varieties measuring from 0.008 mm. to 0.02 mm. In the healthy parts the microzymas were normal, but in proportion as the frozen parts were approached the microzymas were seen to be modified in shape and size.

A fifth illustration was a *Datura Suaveolens,* in which the ends of the branches were frozen. Under the epidermis, as well as deep below, were clouds of *bacterium termo,* some rare *bacterium volutans* and some large bacteria measuring from 0.03 mm. to 0.04 mm. There were also long crystalline needles terminating in spindles of 0.05 mm. to 0.10 mm., which were motionless and not to be found in the healthy parts. The frozen and withered portions had, all the same, remained green.

Through these and many other observations Béchamp became convinced that the microzymas of the plant world have great aptitude for developing into bacteria. But as he never jumped to conclusions, he took the utmost care to make perfectly sure that no inoculation of extraneous organisms could in any way be responsible.

A year later an *Echinocactus Rucarinus*[1] supplied him with an interesting example of the absence of bacteria when their entry from without appeared likely to be facilitated, and thus he seemed to be afforded more proof of his theory that nutritive trouble or a change of environment, like that brought about by frost, may occasion a natural development of internal inherent microzymas.

He happened to enter a conservatory in the Montpellier Botanical Gardens, where he noticed an *Echinocactus* which in so many ways reminded him of the one he had examined a year

[1] *Les Microzymas*, p. 144.

before that it seemed as though this one must also have been frost-bitten. He questioned the gardener, who explained that the roots had rotted owing to the plant having been over-watered. Here again was a subject for the persevering student of Nature. We may be sure that Professor Béchamp did not miss the opportunity. The hard thick surface seemed to him to be intact, but moulds had been formed by large cells of fungi, which had already developed mycelium. Yet, on cutting through this surface, only microzymas and not any bacteria were to be found within the cut, though everything was favourable for an invasion, for there were moulds on the surface and the roots of the plant were rotten.

It is very certain that the Professor, in all the cases we have touched upon, did not content himself with merely a microscopic examination. In each instance he applied chemical tests, and discovered that, roughly speaking, the cell sap of the normal cactus had an acid reaction, whereas that of the frozen parts was found to be slightly alkaline. There were changes, however, which varied with each plant examined, and in a Memoir on the subject,[1] in which these are described, he stated the coincidence of the development of the bacteria and the alkalinity of the medium. He added: "Although the contrary has been believed, bacteria can develop in an acid medium, which may remain acid or become alkaline, as well as they can develop in an absolutely neutral medium." He believed that if it be true that some species of microzymas evolve into bacteria only in neutral or slightly alkaline media, others, none the less, develop in media normally acid.

Béchamp, as we must remember, had been the first to demonstrate with precision the development of a multiplication of air-borne organisms in a suitable medium. Understanding so well the important rôle of the micro-organisms of the air, he was naturally curious to note the effect of their deliberate introduction into surroundings where they would encounter the microzymas, which he considered to be the living formative builders of plant and animal bodies. He therefore inoculated plants with bacteria and attentively studied the results of this foreign invasion. In the sugared solutions that he had used when arriving at the conclusions embodied in his Beacon Experiment of 1857

[1] *Comptes Rendus de l'Académie des Sciences* 68, p. 466 (22nd February, 1869). *Les Microzymas des Organismes Supérieures, Montpellier Médicale* 24, p. 32. *Les. Microzymas,* p. 145.

he had seen the invaders increase and multiply; but now, in the plant interiors, they were in contact with organisms as fully alive as they were. After inoculation, increasing swarms of bacteria were indeed observed, but Béchamp had cause to believe that these were not direct descendants of the invaders. He became convinced that the invasion from without disturbed the inherent microzymas and that the multiplying bacteria he noted in the interior of the plants were, to use his own words,[1] "the abnormal development of constant and normal organisms."

Thus these experiments, which Nature herself had carried out in the Montpellier Botanical Gardens, were to have far-reaching effects upon Professor Béchamp's pathological teaching. They were to prevent his jumping to hasty conclusions like those, for instance, formulated by Pasteur, who imagined animal and vegetable tissues and fluids to be mere inert chemical media[2] like the sweetened solutions in which Béchamp first displayed the part played by air-borne organisms.

These botanical observations were made by Béchamp at an important epoch when the subject of bacteria was beginning to attract much attention. He made his special study of frost-bitten plants at the commencement of the same year, 1868, in which, later, on the 19th October, Pasteur, at the early age of 45, had the misfortune to be struck down by severe paralysis, brought about, he declared, by "excessive toil" in connection with silk-worm disease. But before this, as we have seen, the celebrated chemist had worked hard to exalt the rôle of what he called the germs of the air and to take to himself the credit of the discovery. His pupils and admirers were content to follow his restricted ideas of micro-organisms, and during the sixties one of them, M. Davaine, more or less inaugurated what is now known as the germ-theory of disease-causation.

It came about in this way. A complaint called *charbon*, or splenic fever, and later more commonly known as anthrax, made occasional ravages among the herds of cattle and flocks of sheep in France and other parts of Europe. In 1838 a Frenchman named Delafond drew attention to appearances like little rods in the blood of affected animals, and these were afterwards recognised by Davaine and others. A theory had already been put

[1] *Comptes Rendus de l'Académie des Sciences* 66, p. 863.

[2] *"M. Pasteur ne voyait dans un œuf, dans le sang, dans le lait, dans une masse musculaire, que des substances naturelles telles que la vie les élabore et qui ont les vertus de transformation que l'ébullition détruit." Les Microzymas, par A. Béchamp,* p. 15 (*Avant-Propos.*)

forward in the past by Kircher, Linné, Raspail and others that special organisms might induce disease, and Davaine, becoming acquainted with Pasteur's idea that each kind of fermentation is produced by a specific germ of the air, now suggested that the little rod-like organisms, which he called bacteridia, might be parasitic invaders of animal bodies and the cause of splenic fever, otherwise anthrax. He and others who tried to investigate the subject met with contradictory results in their experiments. It was later, in 1878, that the German doctor, Robert Koch, came to their rescue by cultivating the bacteridia and discovering a formation of spores among them; while Pasteur finally took the matter up and with his fondness for dogmatising declared:[1] "Anthrax is, therefore, the disease of the bacteridium, as trichinosis is the disease of the trichina, as itch is the disease of its special acarus."

Generalisations are always dangerous in a world of contradictions, but, as it has been truly said, "there is no doctrine so false that it does not contain some particle of truth." This wise saying has been quoted by Béchamp,[2] who goes on: "It is thus with microbian doctrines. Indeed, if in the eyes of a certain number of *savants,* doctors and surgeons the system of pre-existing morbid germs were denuded of every appearance of truth and did not seem established on any experimental reality, its reception by these *savants,* who seem to me to have adopted it without going sufficiently deeply into it, would have been absolutely incomprehensible. Incontestable facts, however, seem to support it. Thus it is certain that there truly exist microscopic living beings of the most exquisite minuteness, which, undoubtedly, can communicate the specific diseased condition that is in them. The cause both of the virulence and the power of infection in certain products of the sick organism, or of bodies in a state of putrefaction after death, resides in reality in beings of this order. It is true that people have certainly discovered such beings during the development of certain complaints, virulent, infectious, contagious, or otherwise."

It is thus seen that it was Béchamp's belief that it is this particle of truth in the germ-theory that has blinded so many to its errors. He explains that the want of a fuller understanding is brought about by lack of sufficient knowledge:[3]

[1] *The Life of Pasteur,* by René Vallery-Radot, p. 260.

[2] *La Théorie du Microzyma,* p. 37.

[3] *La Théorie du Microzyma,* p. 38.

"In my eyes, it is because doctors have perceived no relation, no connecting link, between certain histological elements of the animal and vegetable organism and bacteria that they have so lightly abandoned the laws of the great science to adopt after Davaine, and with Pasteur, Kircher's system of pre-existing disease-germs. Thus it comes about that not understanding the real and essential correlation existing between bacteria and the normal histological elements of our organisation, like Davaine, or denying it, like Pasteur, they have come newly again to believe in the system of P. Kircher. Long before Davaine made his observation and considered the inside of the organism to be a medium for development of inoculated bacteria, Raspail said: 'The organism does not engender disease: it receives it from without. . . . Disease is an effect of which the active cause is external to the organism.' In spite of this, the great physicians affirm, in Pidoux' happy words: 'Disease is born of us and in us.' But M. Pasteur, following the opinion of Raspail, and trying to verify the hypothesis experimentally, maintains that physicians are in error: the active cause of our maladies resides in disease-germs created at the origin of all things, which, having gained an invisible entry into us, there develop into parasites. For M. Pasteur, as for Raspail, there is no spontaneous disease; without microbes there would be no sicknesses, no matter what we do, despite our imprudences, miseries or vices! The system, neither new nor original, is ingenious, very simple in its subtlety, and, in consequence, easy to understand and to propagate. The most illiterate of human beings to whom one has shown the connection between the acarus and the itch understands that the itch is the disease of the acarus. Thus it comes about that it has seduced many people who give an unthinking triumph to it. Above all, men of the world are carried away by a specious easy doctrine, all the more applicable to generalities and vague explanations in that it is badly based upon proved and tried scientific demonstrations."

Yes, unfortunately for the great teacher of Montpellier, deeper knowledge, an understanding of that science, cytology, so neglected, as Professor Minchin has complained,[1] even now in the twentieth century, was and still seems to be required to comprehend the profounder, more mystic and complicated workings of pathology. Nature was performing experiments which were open to all to read with the help of the microscope. But few

[1] Presidential Address—British Association, September, 1915.

were sufficiently skilled to probe deep enough under what may often be misleading superficialities. Few possessed enough knowledge to understand the complexities revealed to Béchamp. Yet from the start he warned the world against being misled by too facile judgments. As early as 1869 he wrote:[1] "In typhoid fever, in gangrene, in anthrax, the existence has been proved of bacteria in the tissues and in the blood, and one was very much disposed to take them for granted as cases of ordinary parasitism. It is evident, after what we have said, that instead of maintaining that the affection has had as its origin and cause the introduction into the organism of foreign germs with their consequent action, one should affirm that one only has to do with an alteration of the functions of microzymas, an alteration indicated by the change that has taken place in their form."

The great teacher, who had already so well demonstrated his knowledge of real parasitic disease-conditions by his discovery of the cause of *pébrine,* was surely proving himself to be the best equipped for the understanding of those experiments that Nature undertakes when the normal workings of the body are reduced to chaos and anarchy reigns in the organism. But the majority of mankind, ignorant of the cytological elements, have been delighted with a crude theory of disease which they could understand and have ignored the profound teaching of Professor Antoine Béchamp. It is to what appears to have been Pasteur's attempted plagiarism of these views that we must now turn our attention.

[1] *Comptes Rendus de l'Académie des Sciences* 75, p. 1525.