

## ÉLIE METCHNIKOFF AND THE CAUSE OF SENILE DECADENCE.

BY THE EDITOR.

ÉLIE Metchnikoff, one of the most prominent disciples of Pasteur, has taken his place as Director of the Pasteur Institute. Born in Kharkoff, Little Russia, and having studied in several German universities under the most prominent bacteriologists and zoologists, he became Professor of Zoology and comparative Anatomy at Odessa. The unpleasant political conditions of Russia induced him to leave his native country and settle in Paris, where he became Director of the Municipal Bacteriological Laboratory, and finally was called to replace the great master, the founder of a new conception in bacteriological science, Pasteur.

Metchnikoff devoted special attention to the life of microbes that inhabit living bodies, and he discovered the significance of the white blood corpuscles which are really independent little creatures that serve as scavengers in our bodily system. Their presence is indispensable for the preservation of health, yet they may become injurious if they have no longer the food necessary for their preservation. In that case they will attack the higher tissues and will thus cause all kinds of diseases. These investigations led up to a study of the causes of senility, for Metchnikoff regards the several symptoms of old age as a consequence of hypertrophy of the white corpuscles which, having vanquished and devoured their natural enemies, the microbes, are now obliged for lack of food to attack the nobler organs of the human frame. In this capacity they are called phagocytes, and by debilitating the vitality of the heart, the brains, the lungs, the kidneys, they introduce a slow but inevitable decay of the whole system.

Man thinks himself to be a unit and naturally regards the organs of his body as parts of his being, but if we contemplate the process of life through the spectacles of the bacteriologist, the

unity of man's existence, especially the sentiments, the thoughts, the volitions, are lost sight of, and we have before us a tumultuous world of innumerable little beings the interests of which are strongly opposed to each other, and who wage among themselves a continuous internecine war. We will let Mr. Metchnikoff explain his theory in his own words. He says in his book:\*

"A conflict takes place in old age between the higher elements and the simpler or primitive elements of the organism, and the conflict ends in the victory of the latter. This victory is signalized by a weakening of the intellect, by digestive troubles, and by lack of sufficient oxygen in the blood. The word conflict is not used metaphorically in this case. It is a veritable battle that rages in the innermost recesses of our beings. Distributed through every part of our bodies are certain cells which fulfil special functions of their own. They are capable of independent movement, and also of devouring all sorts of solid matter, a capacity which has gained them their name phagocytes or voracious cells. The function these phagocytes fulfil is a very important one, for it is they that congregate in vast numbers around microbes or other harmful intruders, in order to devour them. Effusions of blood and other elements, on penetrating to parts of the body where their presence is disadvantageous, are absorbed by these phagocytes. In cases of apoplexy, where blood is shed into a part of the brain, setting up paralysis, the phagocytes cluster round the clot and devour the blood corpuscles it has encased. This absorption is a lengthy process, but by degrees, as the pressure of the effusion of blood is removed from the brain, and paralysis disappears, the health of the organism may become completely restored, recovery in such a case being due to the work of the phagocytes.

"The phagocytes may be divided into small active phagocytes, generally known as the microphags, and larger phagocytes called macrophags, which are sometimes active and sometimes still. The former, which are produced in the marrow of the bones, circulate freely in the blood, and occur as some of the white blood corpuscles, or leucocytes. They are distinguishable by their oval shape which facilitates their easy passage through the smaller blood-vessels, and allows of their accumulating in great numbers in the exudations that form around microbes. These exudations may be formed ex-

\* *The Nature of Man*. Studies in Optimistic Philosophy. The English translation edited by F. Chalmers Mitchell, M. A., D. Sc. Oxon., Secretary of the Zoological Society of London. G. P. Putnam's Sons. New York and London. The Knickerbocker Press. 1903.

tremely rapid, and so may arrest infection in the case of many diseases. The microphags may be said to rid us of the microbes, and the macrophags to heal mechanical injuries, such as hæmorrhages, wounds, and so forth. Macrophags possess a single unlobulated nucleus, and occur as white corpuscles in the blood, lymph, and exudations, or as the fixed cells in connective tissues, the spleen, and the lymphatic glands, etc.

“The phagocytes are endowed with a sensitiveness of their own, and by means of a sense of smell or taste are able to recognize the nature of their surroundings. According to the impression made upon this sense, they approach the object which arouses it, exhibit indifference to it, or withdraw from its vicinity. When, however, an infectious microbe finds its way into the body, the microphags are attracted by its excretions and swarm into the exudations surrounding it.

“The macrophags play a very important part in bringing about senile decay. The atrophy of the kidneys in old persons is attributable to their agency. They accumulate in large quantities in these organs clustering round about the renal tubes which they ultimately cause to disappear. Having appropriated the place of the renal tubes, the macrophags proceed to form connective tissue, which thus takes the place of the normal renal tissue. A similar process occurs in the other organs that degenerate in old age. In the brains of old persons and animals, for instance, it is known that a number of nervous cells are surrounded and devoured by macrophags. Judging from the investigations mentioned above, I think I am justified in asserting that senile decay is mainly due to the destruction of the higher elements of the organism by macrophags. This conclusion has been confirmed by means of direct observation, which was the more necessary as it is contrary to the opinions of some biologists.

“Hair, before it has lost its color, is full of pigment scattered throughout the two layers of which each hair is composed. At a given moment, the cells of the central cylinder of a hair become active and proceed to devour all the pigment within their reach. Once they are filled with colored particles, these cells, which are a variety of macrophag (generally called pigmentophags or more properly speaking chromophags), become migratory, and, quitting the hair, either find their way under the skin or leave the body. The coloring matter of the hair is removed in this way by chromophags, leaving the hair colorless.

“The process by which hair becomes white is of importance,

because it shows that the activity of the macrophags is a dominant factor in bringing about senile decay. The brittleness of old people's bones is probably due to a similar cause, i. e., to the absorption and destruction of the framework brought about by macrophags invading the layers of bone. There is still much that remains unknown in this subject, which is well worthy of special research.

"The activity acquired by macrophags during old age is closely connected with the phenomena that are characteristic of certain chronic complaints. Sclerosis in old persons belongs to the same category as organic sclerosis, which may be set up by various morbid influences. The analogy between senile decay of the kidneys and chronic nephritis, commonly called interstitial nephritis, is incontestable. The destruction of nervous cells through the agency of macrophags, which we have already mentioned as occurring in old age, is equally a symptom of several diseases of the nervous centres, such as general paralysis of the insane. Arterial sclerosis in old persons is actually an inflammatory disease, similar to the inflammation of the arteries set up by other maladies.

"The similarity between senility and disease has long been recognized, and partly accounts for the repugnance we all experience at the approach of old age. In childhood and early youth people regard themselves as older than they really are, and long to be 'grown up,' but having once arrived at man's estate they do not wish to grow old. An instinctive feeling tells us that there is something abnormal in old age. It cannot be regarded as a part of healthy physiological function.

"No doubt, because old age is the inevitable lot of mankind, it may be termed normal, in the same fashion as we call the pains of childbirth normal, since few women escape them. In both cases, however, we have to deal with pathological rather than physiological conditions. Just as every effort is made to relieve the suffering woman in labor, so it is natural to try to suppress the evils accompanying old age, but whereas in childbirth an anæsthetic affords relief, old age is a chronic malady, a remedy for which is much harder to find. We have seen that in old age a struggle takes place between the higher elements and the phagocytes, the end being usually a weakening in vitality of the former, while the activity of the latter is enormously increased.

"It would appear, arguing from this, that one means of fighting against old age, pathologically speaking, would be to strengthen the higher elements of the organism, and to weaken the aggressive capacities of the phagocytes. Let me at once warn the reader that

this is not presented as a definite, but as a possible solution of the problem, and is offered for consideration like many other hypotheses on scientific questions. The properties of cellular elements are easily changed when subjected to various influences, and it is therefore not irrational to seek some means of strengthening the blood corpuscles, nerve cells, liver cells, muscular fibres of the heart, and so forth. The task has become easier since the discovery of serums that have specific actions on the tissues."

Metchnikoff's plan to counteract the evils of old age is naturally two-fold. We must prevent the entrance of injurious microbes and we must strengthen the higher tissues which are apt to lose their power of resistance. Professor Metchnikoff, in explaining the differences of the human organism, points out the weakness of the intestines by the large size of the cæcum. He says:

"It is to be noticed that many birds in which the duration of life is long do not possess a cæcum, the portion of the alimentary canal that contains most bacteria. Examination of the intestinal contents of parrots shows that there exist in these birds very few microbes. A comparative study shows plainly that the existence of an abundant intestinal flora, useless for digestion, helps to shorten life by producing bacterial poisons which weaken the higher elements and strengthen the phagocytes.

"The human race has inherited from its ancestors an enormous large intestine and conditions favorable to the life of bacteria. It has to endure the disadvantages of this heritage. On the other hand, the brain of man is very highly developed, and with the increase of intellectual power has come a consciousness of old age and death. Our strong will to live is opposed to the infirmities of age and the shortness of life. Here lies the greatest disharmony of the constitution of man.

"If we desired to make the phenomena of old age physiological rather than pathological, it would be necessary to reduce the evils arising from the presence of a large intestine. It is impossible, I may at once say, to wait for the operation of forces independent of the human will and that might lead to the suppression of an organ which has become useless. Man, guided by exact science, must strive to accelerate or anticipate such a result. In spite of the progress of surgery, I do not expect to find in our time that the large intestine will be removed by operation. Perhaps in the distant future such a proceeding will become normal. For the present it is more reasonable to attack the harmful microbes of the large intestine. In the varied flora of that region there exist microbes

termed anærobic, because they are able to live in the absence of free oxygen, obtaining what they require by the decomposition of organic matter. Such decomposition is attended by fermentations and putrefactions, and the production of poisons, such as the alkaloids (ptomains), fatty acids, and even true toxins.

“Rovighi, an Italian physician, drank daily a litre and a half of *kephir*, a preparation made by subjecting milk to lactic acid and alcoholic fermentations. He found that in a few days the products of intestinal putrefaction in his urine either disappeared or were greatly reduced.

“It is plain, then, that the slow intoxications that weaken the resistance of the higher elements of the body and that strengthen the phagocytes may be arrested by the use of *kephir*, or still better by soured milk. The latter differs from *kephir* in that it contains no alcohol, and alcohol in course of time diminishes the vitality of some important cells in the body. The presence of a number of lactic acid bacteria is inimical to the growth of the bacteria of putrefaction, and so is of great service to the organism.

“But it is not enough merely to introduce useful microbes into the body. We must also prevent the entrance of ‘wild’ microbes, many of which are harmful. Soil, especially when it has been manured, contains large numbers of microbes, some of which are harmful. Bienstock found that the soil of the strawberry beds in his garden contained the bacilli of tetanus. For three weeks he swallowed some of this soil, but found that the bacteria were destroyed in his intestines, which he attributed to the action of the normal bacterial inhabitants of the alimentary canal. It is probable that if this arresting action were weakened the body would be infected by tetanus from the spores of the tetanus microbe swallowed with earth or strawberries or green vegetables. Moreover, besides the organisms of tetanus, there are many other dangerous anærobic bacteria in manured garden soil.

“Obviously we should eat no raw food, but confine our diet rigidly to food that has been thoroughly cooked or sterilized. The exclusion of ‘wild’ microbes and the introduction of beneficial microbes, such as those of lactic acid fermentation, must be of great service to health. I know of individuals who have derived great benefit from such a regimen.

“Science, even in its present imperfect condition, has many weapons by which to prevent or at least diminish the slow and chronic poisoning of the organism that leads eventually to the degeneration of the higher elements. When these elements are being



destroyed by syphilis or alcoholism the struggle must be directed against these evils. It is long since we have known how to do this; that success has not been greater is due to the carelessness of the people who are concerned.

"To strengthen the resistance of the higher elements and to transform the 'wild' population of the intestine into a cultured population, these are the means by which the pathological symptoms may be removed from old age, and by which, in all probability, the life of man may be considerably increased."

Elie Metchnikoff is a great enthusiast as to the significance of science. He dwells on the conflict between traditional religion and modern science, and he proposes to replace the former by the latter. He says, referring to his book:

"If it be true that man cannot live without faith, this volume, when the age of faith seemed gone by, has provided a new faith, that in the all-powerfulness of science."

It is perhaps natural that Metchnikoff, being so absorbed in the problems of his specialty, overlooks the significance of man's psychical and intellectual being. He says: "Too much in man is purely physical system, a commonwealth of microbes." If he had devoted the same painstaking labor to an investigation of the functions of man's soul, he would probably have modified some of his expressions, though the results of his specific labors might have remained the same. Man's soul is not the sum-total of microbic life, but a new factor that is super-imposed upon it through their co-operation. It is a new department that appears in the world of physiological life, and the phenomena of its ultimate constituents only furnish the pedestal upon which it is erected. While some of the labors of Metchnikoff may have to be supplanted,\* while in some of his conclusions he may be too optimistic, especially in his suggestion that at some distant future mankind should be able to prolong life indefinitely, we gladly recognize in him a genuine scientist and a worthy successor of Pasteur.

Metchnikoff concludes his book with the following sentences:

"If there can be formed an ideal able to unite men in a kind of religion of the future, this ideal must be founded on scientific principles. And if it be true, as has been asserted so often, that man can live by faith alone, the faith must be in the power of science."

\* Metchnikoff follows De Vries in assuming a sudden transition from monkey to man. Here we agree, but we deem several theories of Metchnikoff (e. g., his explanation of the origin of the hymen) as vagaries.