

The Germ Theory of Disease.

Some one has said that the great French bacteriologist, Louis Pasteur, found man surrounded by a host of invisible and deadly foes and that by his discoveries he transformed them into friends and servants; and there is much truth in the figure. Up to the middle of the last century the epidemic plague and fever were maladies whose origin was shrouded in the deepest mystery. Remedial measures were almost hopeless without knowledge of the nature of the evil to be attacked. In 1865 Pasteur identified the cause of a fatal disease of silkworms, which threatened the prosperity of a great industry in certain provinces of France, with minute living germs or bacteria, which swarmed in the bodies of the diseased worms. At once a new field of research lay fallow for cultivation. Splenic fever in cattle and in men was shown to be due to a similar cause, and in quick succession were discovered the specific microbes of tuberculosis, cholera, diphtheria, tetanus and typhoid fever.

Then there came a lull in great advances along this line. Efforts to find bacteria which could cause the acute eruptive diseases proved unavailing. Only within the last five years certain English and Italian observers in the study of malaria introduced a second epoch of progress. They proved that the organism which causes malaria was carried from person to person by the bite of a certain mosquito in whose body it undergoes part of its life changes. This microbe is of a totally different type from those with which Pasteur worked, belonging to the lowest group of animals, the Protozoa, while the Bacteria are plants. The Protozoa must be studied by special methods and as soon as the attention of the scientific world was drawn to them many puzzling problems seemed near solution. Dr. W. T. Councilman of the Harvard Medical School announced last spring the discovery of a Protozoön in small-pox; a party of surgeons of the U. S. Marine Hospital service have described what they believe to be the organism which causes yellow fever; and less than a month ago Dr. F. B. Mallory of the Harvard Medical School described a Protozoön found in scarlet fever. Much remains to be done in the study of these animal parasites; but everywhere experts are attacking the problem, foremost among

them being G. N. Calkins, M. I. T., '90, Course IX., Professor of Zoölogy at Columbia.

Practically the study of the micro-organisms of disease has helped us in two ways. It has taught us first how to destroy these microbes before they can enter the body at all. Typhoid fever and cholera may thus be prevented by supervision of water and milk supplies and by the removal and disinfection of excreta. Tuberculosis may be checked by properly caring for the sputum of tuberculous patients. Malaria is controlled by the extermination of mosquitoes.

In the second place the vital resistance of the body may be strengthened so that the germs which have already entered will find there an unfavorable environment and will quickly perish. The cells of the body may produce specific antidotes which neutralize the poisons of the bacteria and destroy the bacteria themselves, and this occurs in every case when recovery from an infectious disease is followed by immunity against that disease for a longer or shorter period. By introducing weakened cultures of the bacteria themselves, a small portion of their poisons or toxins, an artificial immunity may be produced without danger. This is what occurs in vaccination, and in the case of diphtheria the process is carried one step farther. Diphtheria bacilli are cultivated in a broth in which they secrete their toxins. The latter, in gradually increasing doses, are injected into the veins of a horse until his blood becomes richly charged with the antidote or antitoxin. This blood is then drawn off and injected into the veins of children strangling in the throes of diphtheria; it does its beneficent work and saves thousands of lives which would otherwise be lost. Here indeed it seems that the very enemy himself has been made captive and forced to undo the evil he has caused.

As a result of the researches of Pasteur and his followers, typhoid fever, cholera, diphtheria, yellow fever, malaria and other less familiar maladies are preventable diseases which we shall wholly abolish when we put in practice the theoretical knowledge we possess. New possibilities are opening before us every year and it is not unreasonable to hope that some day the infections may one and all be banished from the earth.

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