

man journal is that the Pasteur method has yet need for demonstration as to its utility.

On the whole, however, the facts presented apart from bias are undoubtedly in favor of the method. They show (1) perfect agreement on the scientific value of the method; (2) practical and economic advantages of the method as practiced amongst cattle.

#### The Theory of Immunity from Contagious Diseases

For many years this vexed question has been discussed, and although Pasteur and Davaine have given to it the attention of the highest scientific attainment, still there is much yet undetermined. Acquired immunity has as usually given three explanations: (*a*) a substance is formed in the body during the disease unfavorable to the multiplication of microbes; (*b*) a substance favorable to the growth of these microbes is exhausted during the disease: or (*c*) the living matter of the body might acquire the power to resist or prevent the growth of microbes.

Pasteur gives reasons for belief in the second, or *exhaustion* theory, and supports it by the fact that a culture after evaporation *in vacuo* without heat and then being brought back to its original volume with fresh culture fluid will cause the microbe to grow again, whereas, had some new poisonous principle been evolved, the new culture should have proved sterile.

A difficulty which appears at the outset in the exhaustion theory is that the body, by a process of assimilation and exertion, not only must make new materials similar to those previously used up, but also throws off very soon what might prove injurious. Prof. D. E. Salmon, Agricultural Department, Washington, who has spent a number of years investigating this, among other subjects, has further pointed out that, if a *bouillon* be made of the muscles of a fowl made insusceptible to cholera by inoculations and sterilized, the microbe of chicken cholera will multiply in it just as readily as in a *bouillon* made from a susceptible fowl.

Thus it appears that both the exhaustion and antidotal theories fail to explain immunity, and Salmon reverts to the third or *vital resistance* theory. He says, "Immunity is probably never absolute, but simply relative." This seems to have been proved in many ways; amongst others, by the fact that in vaccine stables operators have been known

to have vaccine vesicles two or three times in a couple of years, at points of abrasion on the hands or arms. Chauveau, Salmon, etc., have proved that sheep, fowls, insusceptible to ordinary *doses* of virus have succumbed to sufficiently increased doses. Salmon says that such facts "indicate that the tissues of the most susceptible individuals are not suited to the growth of microbes when the functions of the cells are normally performed; because, if favorable, one germ introduced into the interior of the body would multiply just as it does in a culture flask, and finally would produce the disease with the same certainty as would a million. This not being the case, it is evident that by increasing the dose the resistance of the tissues is in some way overcome and the disease is produced." That it is vital activity which resists seems evident from the fact that the bacteria of putrefaction will not multiply in the body during its life, but immediately after the death thereof. But how, in any case, is the vital resistance of cells overcome? Salmon has suggested that the cells have a normal activity, they keep oxygen so completely removed from blood that microbes requiring it cannot live. Metschnikoff thinks a struggle goes on between bacteria and wandering cells (phagocytes). According to Salmon, Zuelzyer and Riemsneider, have found that microbes introduced into the blood may produce no effects, but, if after their introduction a few minims of atropia be injected a septicæmia will ensue. Thus a narcotic opens the way for further multiplication. Other extended experiments by Chauveau, Hiller, etc., all go to show that the poisonous principles (*ptomaines*) elaborated in cultures by microbes, while not by themselves producing poisonous effects, will, if injected along with microbes, allow the latter to multiply. Salmon's most recent investigations at the Bureau of Animal Industry, into the nature of swine plague have proved that the microbes of the disease elaborate in their multiplication a poisonous principle which, when tested with on the circulation of small animals, produced effects almost identical with those caused by atropia.

Summing up, Salmon says, "We can readily understand how a relatively large dose of virus overwhelms the animal cells at the point of its introduction with its peculiar poison, arrests their activity, prevents them from withdrawing the oxygen, at least to the normal degree, from the liquids