

offshoots from animal cells, as, for instance, of blood corpuscles; all these views are untenable in the face of the overwhelming number of collected observations which, without exception, go to show that we have here to deal with *well defined species*.

The idea that micro-organisms must be the cause of infectious diseases was early expressed by several leading spirits, but general opinion could not bring itself to accept the notion, and showed itself very sceptical with regard to the first discoveries in this domain. All the more was it desirable in the first cases to prove on irrefutable grounds that micro-organisms found in an infectious disease are actually the cause of that disease. At one time the objection was always brought forward that there was nothing more than an accidental coincidence between the disease and the micro-organisms, that the latter did not play the part of dangerous parasites but of harmless guests which found in the diseased organs conditions of life which were wanting in healthy bodies. Many, while acknowledging the pathogenic properties of the bacteria, believed it possible that, under the influence of the morbid process, micro-organisms, accidentally or constantly present, which were otherwise harmless, became transformed into pathogenic bacteria.

If, however, it can be proved,—first, that the parasite is met with in each individual case of this particular disease, and under conditions which correspond to the pathological changes and the clinical course of the disease; secondly, that in no other disease is it found as an accidental, non-pathogenic guest; and thirdly, that if completely isolated from the body, and cultivated in pure cultures with sufficient frequency, it can reproduce the disease—then, it can no longer be considered an accidental accompaniment of the disease, but in that case no other relation between the parasite and the disease can be admitted than that the parasite is the cause of the disease.

This proof has now been furnished in the fullest measure with regard to a

number of infectious diseases, such as anthrax, tuberculosis, erysipelas, tetanus, and many diseases of animals—generally all those diseases which are communicable to animals.

At the same time it has further been shown that in all the cases in which the constant and exclusive occurrence of bacteria in an infectious disease has been established, the latter never behave as accidental guests, but like the bacteria already certainly known to be pathogenic. We are therefore fully warranted in affirming that if even only the first two requirements of the proof are fulfilled—that is to say, if the constant and exclusive occurrence of the parasite is established—the causal connection between parasite and disease is validly proved. Starting from this basis, we must admit that a series of diseases in which the experimental infection of animals has hitherto failed or been only partially successful are, in spite of this, to be regarded as parasitic. Among these diseases are typhoid fever, diphtheria, leprosy, relapsing fever, and Asiatic cholera. I wish to call special attention to cholera in this connection, inasmuch as the inclusion of it among parasitic diseases was opposed with extraordinary pertinacity. Every imaginable effort was made to rob the cholera bacteria of their specific character, but they have victoriously resisted all attacks, and it can now be regarded as a universally admitted and firmly established fact that they are the cause of cholera.

As to direct sunlight, it has been well known for some years that it kills bacteria with tolerable quickness. I can affirm this as regards tubercle bacilli, which were killed in from a few minutes to some hours, according to the thickness of the layer in which they were exposed to the sunlight. What seems to me, however, to be particularly noteworthy, is that even ordinary daylight if it lasts long enough, produces the same effect; cultures of tubercle bacilli die in five to seven days if exposed at the window in compact masses.