tion and disease, —that ancient Will-o’-the-wisp “ spontane­ous generation ” being revived by the way. When Pas­teur in 1857 showed that the lactic fermentation depends on the presence of an organism, it was already known from the researches of Schwann (1837) and Helmholtz (1843) that fermentation and putrefaction are intimately con­nected with the presence of organisms derived from the air, and that the preservation of putrescible substances de­pends on this principle. In 1862 Pasteur placed it beyond reasonable doubt that the ammoniacal fermentation of urea is due to the action of a minute Schizomycete ; in 1864 this was confirmed by Van Tieghem, and in 1874 by Cohn, who named the organism *Micrococcus ureae,.* Pasteur and Cohn also pointed out that putrefaction is but a special case of fermentation, and before 1872 the doctrines of Pasteur were established with respect to Schizomycetes. Meanwhile two branches of inquiry had arisen, so to speak, from the above. In the first place, the ancient question of “ spontaneous generation ” received fresh impetus from the difficulty of keeping such minute organisms as bacteria from reaching and developing in organic infusions; and, secondly, the long-suspected analogies between the pheno­mena of fermentation and those of certain diseases again made themselves felt, as both became better understood. Needham in 1745 had declared that heated infusions of organic matter were not deprived of living beings ; Spal­lanzani (1777) had replied that more careful heating and other precautions prevent the appearance of organisms in the fluids. Various experiments by Schwann, Helmholtz, Schultz, Schroeder, Dusch, and others led to the refutation, step by step, of the belief that the more minute organ­isms, and particularly bacteria, arose *de novo* in the special cases quoted. Nevertheless, instances were adduced where the most careful heating of yolk of egg, milk, hay- infusions, &c., had failed,—the boiled infusions, &c., turn­ing putrid and swarming with Schizomycetes after a few hours.

In 1862 Pasteur repeated and extended such experi­ments, and paved the way for a complete explanation of the anomalies; Cohn in 1872 published confirmatory results ; and it became clear that no putrefaction can take place without Schizomycetes. In the hands of Brefeld, Burdon-Sanderson, De Bary, Tyndall, Roberts, Lister, and others, the various links in the chain of evidence grew stronger and stronger, and every case adduced as one of “spontaneous generation” fell to the ground when examined. No case of so-called “spontaneous genera­tion ” has withstood rigid investigation ; but the discussion contributed to more exact ideas as to the ubiquity, minuteness, and high powers of resistance to physical agents of the spores of Schizomycetes, and led to more exact ideas of antiseptic treatments. Methods were also improved, and the application of some of them to surgery at the hands of Lister, Koch, and others has yielded results of the highest importance.

Long before any clear ideas as to the relations of Schizomycetes to fermentation and disease were possible, various thinkers at different times had suggested that resemblances exist between the phenomena of certain diseases and those of fermentation, and the idea that a virus or contagium might be something of the nature of a minute organism capable of spreading and reproducing itself had been entertained. Such vague notions began to take more definite shape as the ferment theory of Cagniard-Latour (1828), Schwann (1837), and Pasteur made way, especially in the hands of the last-named savant. From about 1870 onwards the “ germ theory of disease” has passed into acceptance. Rayer in 1850 and Davaine had observed the bacilli in the blood of animals dead of anthrax (splenic fever), and Pollender discovered

them anew in 1855. In 1863, imbued with ideas derived from Pasteur’s researches on fermentation, Davaine re­investigated the matter, and put forth the opinion that the anthrax bacilli caused the splenic fever; this was proved to result from inoculation. Koch in 1876 pub­lished his observations on Davaine’s bacilli, placed beyond doubt their causal relation to splenic fever, discovered the spores and the saprophytic phase in the life-history of the organism, and cleared up important points in the whole question (figs. 10 and 11). In 1870 Pasteur had proved that a disease of silkworms was due to a ferment-organism of the nature of a Schizomycete ; and in 1871 Oertel showed that a *Micrococcus* already known to exist in diphtheria is intimately concerned in producing that disease. In 1872, therefore, Cohn was already justified in grouping together a number of “ pathogenous ” Schizomycetes. Thus arose the foundations of the modern “germ theory of disease”; and, in the midst of the wildest conjectures and the worst of logic, a nucleus of facts was won, which has since grown, and is growing daily. Septicaemia, tuberculosis, glanders, fowl-cholera, relapsing fever, and a few other diseases are now brought definitely within the range of biology, and several other contagious and infectious diseases are known to be also due to Schizomycetes.

Other questions of the highest importance have arisen from the foregoing. A few years ago Pasteur showed that *Bacillus anthracis* cultivated in chicken broth, with plenty of oxygen, and at a temperature of 42-43° C. lost its virulence after a few “ generations,” and ceased to kill even the mouse ; Toussaint and Chaveau confirmed, and others have extended the observations. More remarkable still, animals inoculated with such “attenuated” bacilli proved to be curiously resistent to the deadly effects of subsequent inoculations of the non-attenuated form. In other words, animals vaccinated with the cultivated bacillus showed immunity from disease when reinoculated with the deadly wild form. The questions as to the causes and nature of the changes in the bacillus and in the host, as to the extent of immunity enjoyed by the latter, &c., are now burning,—Metschnikoff’s recent observations (1884), show­ing that the white corpuscles eliminate the bacilli from the blood, being one of the most startling contributions to the answers.

Another burning question has already been in part touched upon. Experiments have shown that Schizomy­cetes are pleomorphic ; they are also very sensitive, so to speak, to the influences of the environment. The investi­gations of Cohn, Pasteur, Koch, Nägeli, Kurth, De Bary, and others leave no doubt that many Schizomycetes are sensibly affected by the media in which they are cultivated : not only are the forms modified, but also the physiological activity varies in degree, and even in kind. These and similar facts seem to be largely responsible for recent ideas as to the possibility of being able to cultivate or “ educate ” certain Schizomycetes. One case only need be referred to. *Bacillus anthracis* and *B. subtilis* are only distinguish­able with great difficulty morphologically *(cf.* figs. 10-12) ; the former is parasitic in its vegetative stages, the latter is always a saprophyte. Now *B. anthracis,* as said, can become harmless by cultivation, and so it has been thought that the two forms were convertible. Buchner even went so far as to declare that he had transformed *B. anthracis* into *B. subtilis, i.e.,* that the differences which botanists detect are only due to the influence of the environment at the time. These assertions cannot be regarded as proved ; but the question whether harmless forms can become edu­cated, as it were, to a parasitic mode of life within periods which we can control is of course of the highest import­ance. Such are a few of the questions now under discussion, together with others as to the mode of action of patho-