genic Schizomycetes, as to the nature of immunity, and as to the limitation of “ species ” among such simple forms. @@1

Morphology.—*Sizes, Forms, Structure, &c.—*The Schizo- mycetes consist of single cells, or of filamentous or other groups of cells, according as the divisions are completed at once or not. While some unicellular forms are less than 1μ (·001 mm.) in diameter, others have cells measuring 4μ, or 5 μ or even *7* μ or *8* μ in thickness, while the length may vary from that of the diameter to many times that measure­ment. In the filamentous forms the individual cells are often difficult to observe until reagents are applied *(e.g.,* fig. 14), and the length of the rows of cylindrical cells may be many hundred times greater than the breadth. Simi­larly, the diameters of flat or spheroidal colonies may vary from a few times to many hundred times that of the indivi­dual cells, the divisions of which have produced the colony. The shape of the individual cell (fig. 1) varies from that of a minute sphere to that of a straight, curved, or twisted filament or cylinder, which is not necessarily of the same diameter throughout, and may have flattened, rounded, or even pointed ends. The rule is that the cells divide in one direction only—*i.e.,* transverse to the long axis—and therefore produce aggregates of long cylindrical shape ; but in rarer cases iso-diametric cells divide in two or three directions, producing flat, or spheroidal, or irregular colonies, the size of which is practically unlimited. As to the structure of the cell, little more can be said than that it consists of a mass of homogeneous or very slightly granular protoplasm, with a pearl-like lustre, and without vacuoles ; this is enveloped by a membranous envelope, which is so delicate as to be scarcely perceptible. In the actively vegetating or mobile conditions this cell wall appears very thin and sharp, and is extremely flexible and elastic, but at other times it is swollen and diffluent, fur­nishing the intercellular gelatinous matrix of the zooglœa condition (fig. 3). It is doubtful whether the thin envelope closely applied to the protoplasm is not always simply the innermost layer of a very diffluent covering, which is con­tinuously thickening and throwing off its outermost swollen and disorganized lamellae. The facts to hand seem to show that, while in some cases this envelope consists mainly of cellulose, in others (zooglœa of *Bacteria, e.g.)* it contains relatively large proportions of nitrogenous compounds. In some cases the cell-walls form a lamel- lated sheath. No cuticularization occurs, nor are deposits of lime or silex known in the cell walls. Colouring pigments, however (red, yellow, and even green and blue), are sometimes met with, and a rusty or brown tinge is in some cases produced by the precipitation of iron oxides in the walls. In the typical Schizomycetes the protoplasmic contents (which are said to consist largely of a peculiar substance named mycoprotein) are colourless, or more rarely tinged with colouring matters—bright red, yellow, &c.—which cannot be mistaken for chlorophyll. The few forms described as containing a green pigment, allied to or identical with chlorophyll, will not be considered here, but relegated to the *Algse.* The occurrence of starch or a granulose-like substance in some *Bacteria* is undoubted; it yields a deep blue colour with iodine solutions, is diffused in bands or patches, and arises in cases where

the Schizomycete is nourished by a matrix which does not contain starch. Trécul noticed this formation of amyloid substance in *Clostridium,* Van Tieghem in a *Spirillum,* and several other cases are known ; Ward detected starch in a *Bacillus* found in decaying coffee seeds, and in other media devoid of starch. In the filamentous Schizomycetes *(Beggiatoa, e.g.)* are found extremely minute dark gran­ules ; Cramer and Cohn have shown that these consist of sulphur in fine crystals (fig. 14). Oily or fatty substances and minute granules of undetermined nature occur in the protoplasm, but no nucleus has as yet been discovered in any Schizomycete.

*Vegetative States.—*While many forms are fixed to a substratum, others are free ; and in certain conditions single cells or groups may be motile. In some cases the movements are mere oscillations, in others there are rapid movements of translation, sometimes ascribed to the action of flagella or cilia ; these movements are of course not to be confounded with the dancing “Brownian motion” observed in the case of all such minute bodies suspended in fluids. Cilia have now been described in some of the smallest *Bacteria* by several good observers (Dallinger and Drysdale, @@2 Cohn, Koch, Zopf), though, on account of their extreme fineness, and the difficulty of fixing them, much discussion has

taken place as

to their nature,

functions, origin,

numbers, and

even existence ;

that they occur

is proved by the

photographs, but

whether they are

not sometimes

mere filaments

drawn out from

the cell-walls is

very doubtful

(figs. 2 and 12).

While some Schi­zomycetes appear

to have no active

stage, and many

are only motile

under certain

conditions when

swarming, others

are described as

possessing two or

even three dis­tinct active forms.

When vigorously

growing and di­viding, the Schi­zomycetes as a

rule present certain definite forms, which are at any rate so constant under constant conditions that they can be figured and described with such accuracy and certainty that good observers have regarded them as fixed species, or at least as “ form-species ” or “ form-genera.” We now know, however, that many Schizomycetes pass through several such phases, and we may therefore regard them in these cases as “vegetative forms,” which pass into one another too gradually to admit of their being employed as sharply distinctive of genera.

As the chief of these forms may be mentioned the following (see fig. 1) :—

@@@1 In addition to the foregoing, compare Nägeli, *Untersuchungen über niedere Pilze,* 1882 ; Buchner, *ibid.,* and in *Virch. Arch.,* xci., 1883 ; Nägeli, *Theorie der Gährung,* 1879 ; Chaveau in *Comptes Rendus,* 1879-1884 ; Davaine, *ibid.,* 1863-64 and 1873; E. Ray Lankester, *Quart. Jour, of Micros. Sc.,* 1873 and 1876 (also valuable papers in *Q. J. M. S.* from 1870 to 1884); Pasteur, numerous papers in *Comptes Rendus—*especially 1862 and 1877—and in *Ann. de Chim. et Phys.,* 1858, 1862, &c. ; Koch in *Cohn’s Beitr.,* ii. Hft. 2, 1876 ; Kurth, *Bot. Zeitung,* 1883; Schützenberger, *Fermentation,* 1876; Metschnikoff, *Virch. Arch.,* 1884 ; *Nature,* various papers from 1871 to 1878.

@@@2 Dallinger and Drysdale, *Monthly Micros. Jour.,* 1875.