

hope that even cell-division will yield to physiological analysis, that is to say, that some proximate solution will be arrived at.

A general rationale of why cell-division should take place seems to have been suggested independently by Leuckart, Spencer, and Alexander James. It is often referred to as the Leuckart-Spencer principle. Why do not cells go on growing larger and larger? why do they almost always divide at a *limit of growth* more or less definite for each kind of cell in given surroundings? The answer is as follows:—Suppose a young cell, spherical in form, to have doubled its original mass by growth, that means that there is twice as much living material to be kept alive. But the living material is fed, aerated, and purified through the cell-surface, which only increases as the square of the radius, while the mass increases as the cube. The extension of surface *must* lag behind the increase of mass. Therefore when the cell has, let us say, quadrupled its original mass, but by no means quadrupled its surface, physiological difficulties set in, the normal ratio between repair and waste, construction and disruption, is seriously disturbed. At the limit of growth, then, the cell divides, halving its mass, and gaining new surface. It is true that surface may also be increased by outflowing processes, just as that of a leaf is by the formation of many lobes; and it is true that division may occur before the limit of growth is reached, but as a general rationale, quite different from physiological analysis, the Leuckart-Spencer principle seems a useful suggestion, and it is applicable to organs and to bodies as well as to cells.

An interesting suggestion in regard to the forms and phases of cell-life is due to Prof. Patrick Geddes.

The Cell-cycle. It may be called the conception of a cell-cycle.

(1) In the life-history of one of the simplest organisms ever described—Hæckel's *Protomyxa*—there are four chapters. In one chapter, the organism is encysted and breaks up into spores. These spores escape as minute lashed (flagellate) units. As they feed, they sink into an amœboid form, like minute irregular drops of