stances are formed in living bodies exactly in the same way as the chemist can imitate many of them in his laboratory, although his apparatus is very inferior to that which nature employs.

We conclude a simple plant like the yeast-cell to be truly alive, because it not only changes the food-matter with which it comes into contact, but assimilates it, and passes through a real growth. In Dr. Montgomery's experiments his particles of myeline did not transform any adjacent matter. They absorbed water, which enlarged them, and they exhibited purely physical change, varied according to the viscidity or limpidity of the fluids surrounding them. In this there was nothing truly resembling life, though the process may be identical with *some* of the processes which living cells exhibit. When we come to consider what we mean by calling a simple cell *alive* we have to discard all the higher conceptions of life, as it exists in animals, or in man. The yeast-plant, for example, consists of little bladders or cells, containing a substance in which nitrogen figures as a constituent. It takes in surrounding matter, it appropriates it, works a chemical change in it, enlarges itself, and makes offspring, or buds, with one portion of the material, and leaves the rest as the alcohol and carbonic acid which result from fermentation. The chemist can trace the nature of these operations, which differ from his own experiments chiefly in this, that the yeast-plant, which is a chemical apparatus for transforming sugar according to a definite formula, reproduces itself, and gives rise to a numerous progeny, all capable of doing the same work. But the yeast-plant is only one of a series of forms capable of acting as ferments, though not limited to the alcholic kind.

Smaller than the yeast-plant, and the blue moulds, and other forms which belong to the same series, and are more or less convertible one into the other, are the vibrions, bacteriums, and similar organisms. The vibrions are, as most of my readers know, minute beaded chains, more or less spiral, from about 1—430″ to 1—9200, or less, in length, and of proportionate tenuity. Bacteriums are stiff, rod-like bodies, equally, and more minute: and spirium is an elegant and very delicate helix, moving with a beautiful screw motion. Many microscopists, especially in France, call these things, or most of them, *animals*, but they are probably either vegetable, or should be arranged in a group by themselves. Little regard can be paid to divisions of them into *species*, if by that is meant that their off-spring will always resemble their parents, but distinct forms have specific powers as ferments. When organic matter is decomposed under ordinary conditions, some of these organisms invariably appear, and they seem to act as the chief agents of the chemical changes that occur. By what means they move is not known. Dujardin and Ehrenberg have ascribed locomotive filaments to some of them, but I have never seen anything of the kind, and conjecture their motions are the consequence of actions of endosmose, exosmose, and contraction and expansion, arising therefrom.

Minute objects of this kind are usually the subjects of discussion when the spontaneous generation controversy crops up, and from their extreme smallness, and the facility with which they appear, it is very difficult to trace either their structure or their origin. A single cell is probably capable of producing them, and that may be so small, that a negative decision as to its existence in any fluid or solid cannot be worth much, except we can satisfy ourselves that we have rendered all life impossible in the *substance* to which reference is made.

M. Pouchet is now the leader of those whom it is the custom in England to call "Spontaneous Generationists," but that term is incorrectly applied to him and to his colleagues, MM. Jolly, Musset, and others. Pouchet adopts the term, "heterogenesis," which, as we have shown, he describes as a method of generation differing from that by means of eggs, or buds, and yet in affinity with it. As an account of Pouchet's theories was given in the "Intellectual Observer" vol. i., p. 85, I need not now describe it at length, but shall advert to one or two points. He says, "If, in our experiments, proto-organisms develope themselves by contact of divers bodies, we must not suppose the cause of their appearance is absolutely under the influence of affinities; this would be to lower creation to the level of chemical attraction;" and he goes on to profess his agreement with Bremser, who alleges "spirit" to be the principal cause of life, which he declares does not arise from such a mingling of substances as the chemist can produce. Pouchet considers that it is "an immense error to regard reproduction as an act accomplished by the mother." The mother, he says, does not make the egg, which he supposes to be animated with a "vital force" of its own from the moment its two first molecules come together. He considers that fermentations and putrefactions "disengage organic molecules," and prepare the way for fresh combinations. First, he says, may be noticed in infusions a pellicle, which grows thicker, and becomes what he calls the "prolific pellicle." It is, he says, composed of the remains of animalcules, and acts as an improvised ovary, in which others are generated. At first, organizable matter in infusions, according to his views, in a state of solution, but in the course of fifteen or twenty hours, at a sufficient temperature, and under the influence of air, minute corpuscules appear, at first motionless, but afterwards moving in a way that distinguishes them from inorganic particles in molecular motion; they are, he says, monads of the smallest kinds.

Passing from theories of heterogenesis to experiments, the thing to be ascertained is whether any bodies possessing organic life vegetable or animal, are produced in solutions or fluids in which all germs have been destroyed, and from which they are excluded. The opponents of heterogeny and similar hypotheses, explain the appearance of animalcules in solutions exposed to the air, by referring them to germs, or eggs, floating about in the atmosphere, and ready for development if they fall under suitable conditions. M. Pouchet calls those who hold this view "Panspermists," and challenges them to prove the existence of the quantity of diffused germs their theory requires. He likewise continues, year after year, to adduce experiments in which Infusoria appear, although the fluids in which they occur have been boiled, and the only air admitted has been passed through red-hot tubes, or sulphuric acid. In another class of his experiments he obtains special growths under special conditions, and asks if we can believe that the air contains a great variety of germs capable of such varied development. He affirms that, "by varying to infinity the solid substance of an Infusoria, where the same air and water are used, the Infusoria will equally vary infinitely as the character of the solution varies." This may be tested by any microscopist, and I think the result will scarcely correspond with the very wide assertions M. Pouchet makes. One of his experiments in free air is a very pretty one, from his description, but I cannot speak of it from my own experience. He places some paste, made with wheat flour and boiling water, in a flat porcelain trough, so as to form a layer about one centimetre thick. When the paste begins to solidify, he traces letters on it with a brush, dipped in a strong infusion of galls which has been filtered. He covers the vessel over with a plate of glass, and in four days finds the letters in *black*, composed of a microscopic fungus he calls *Aspergillus primigenius*. He tells us that only where the infusion of galls has acted do any organisms appear.

In opposition to a multitude of experiments by M. Pouchet and his companions, MM. Joly, Musset, etc., M. Pasteur adduces a quantity of his own experiments, the result of which is to show that if organisms and germs are destroyed by boiling, and the vessels sealed, or only allowed access to air deprived of germs, no life of any kind appears. M. Pasteur's experiments have been usually regarded as conclusive in this country, and they certainly seem to be more exact than most of those adduced on the other side; but he does not use high powers with his microscope, and it is difficult to reject counter experiments which are alleged to have yielded opposite results, and to have been made with equal care.

Among the most noteworthy of these experiments are those which Dr. Gilbert W. Child has brought before the Royal Society, and which are collected together, with some additional matter, in a volume just published. (1) Dr. Child's first set of experiments were made with milk, and fragments of meat and water, placed in glass bulbs about two inches and a half in diameter, and having two narrow and long necks. "In one series the bulbs were filled with air previously passed through a porcelain tube containing fragments of pumice-stone, and heated to vivid redness in a furnace. In the others they were respectively filled with carbonic acid, hydrogen, oxygen, and nitrogen gases." The matter in some bulbs was boiled, and in others not. The joints of the apparatus were formed by nonvulcanized india-rubber tubing and india-rubber corks, previously boiled in a solution of potash. In every case but one, in which the substances had not been boiled, low organisms were found, and the bulb in which these were not seen burst from some fermentation, probably associated with life. In the boiled bulbs, no sign of life appeared in those filled with carbonic acid, or in those filled with hydrogen; but organisms did appear in that filled with the heated air, and in the milk bulb filled with oxygen. The oxygen and meat bulb burst spontaneously.

In another set of experiments Dr. Child used a porcelain tube partly filled with grounded pumice, one end being connected with a gasholder, and the other with the bulb holding the putrescible matter. The bulbs had two necks as before, one connected by means of an india-rubber cork with the porcelain tube, and the other bent and inserted in sulphuric acid. "The central part of the tube con-

(1) "Essays on Physiological Subjects." By Gilbert W. Child, M.D., F.L.S., F.C.S., of Exeter College, Oxford. Longmans.