

LITTLEFIELD AND THE ARTIFICIAL CREATION OF LIFE.

BY CHARLES EDWARD TINGLEY.

Succeeding the experiments of Loeb and prior to those of Burke were those announced by Dr. Charles Littlefield, but since the claims of the latter were so exceedingly broad and the methods employed so very loose the scientific world has paid very little attention to them. Nevertheless, a widespread interest has been created in the man and his work by the popular press, for the subject is one which appeals no less strongly to the lay than to the technically-trained mind. For this reason a critical review of his experiments may not be ill-timed.

What lends a glamor to the researches of this biologist is the fact that he cherishes the illusion of having actually produced not only the simple organic cell, but also a much higher and more complex form of life. The method by which he has generated supposed life in a sterile soil he does not seek to conceal, but instead gives a clear and connected account of it as well as of the theory upon which it rests, and though one may well find fault with the first, certainly no objection can be raised to the second.

The following instructions and description of the operation have been given by Dr. Littlefield by which the micro-organisms are supposed to be produced. The supplies are of the simplest kind and can be obtained in any drug store. These comprise a large but shallow glass vessel, having a capacity of one quart, several smaller glass dishes, a bell jar sufficiently large to inclose these receptacles, and finally, a good high-power microscope. The chemicals used are sodium chloride, or common table salt, alcohol, ammonia, and distilled water. In the larger vessel 2 ounces of the salt is dissolved in 6 ounces of the water, and when this is done 6 ounces of 90 per cent pure alcohol is added.

A portion of the solution thus formed is poured out of the larger into the smaller dishes, when 2 ounces of officinal aqua ammonia is stirred in with a clean glass rod, and the bell jar is then placed over them. A chemical reaction is set up and in the course of a few minutes bubbles of hydrogen will begin to form on the surface of the fluid, and a closer observation will show these little spheres to be gyrating with high velocity. In the course of half an hour the bubbles will cease to form; the liquid is then ready for the crucial test. With the micro-

scope at hand and previously focused so that a globule of the unstable solution may be quickly observed, a very small portion is transferred from the dish to the glass slide, where the latter is adjusted on the stage and a magnified view is had. On examination detached particles of matter are seen moving through the medium from the center to the circumference with extreme rapidity, and continued investigation indicates other changes the liquid is undergoing. Crystals begin to appear, and those first formed are the characteristic transparent cubes of sodium chloride, and hence these are incapable of further development. After these, other crystals follow, and some assume a hexagonal form on the surface of the saturated solution, and it is from these latter minute six-sided bodies that the growth of the elementary organisms is said to take place.

The point is now reached, according to Dr. Littlefield, where the intangible force we know as life joins the lifeless matter, as current electricity energizes a coil of wire, and a microscopic organism possessing what Herbert Spencer defines as the "co-ordination of actions" begins its existence, which consists of a series of definite and successive changes, both in structure and composition, which take place within itself and without destroying its identity.

The growth of this supposed rudimentary vital element next follows in sequence, and as it is metamorphosed from the hexagonal crystal into a free, smooth, disk-shaped cell, we are informed that it bears a close resemblance to a red-blood corpuscle. The cellular disk now gradually expands in a direction at right angles to its surfaces and an ovoid form results

from which pseudopodia or temporary extensions protrude similar to the amœba, and which in the latter are designed to take in food, for locomotion, etc.

In commenting on his achievements, the doctor says: "I have carefully watched the development of a large number of these cells or germs, and they do not vary in the least detail as to their growth from the above description, showing unmistakable design and the actuality of life's processes. Moreover, mineral substances do not change except by accretions from without, and then not always in regular form and order. From the result of my experiments I am forced to conclude that there are two factors responsible for the manifestation known as life; one is a force or influence due to certain vibrations of the ether, and the other is a certain combination of atoms so arranged as to be capable of responding to these impressed vibrations. As an illustration, they act somewhat as the rods and cones of the optic nerve in the retina of the eye, which are so constituted that they may receive and focus certain vibrations of the luminiferous ether, giving us the phenomena of light and the sensation of sight. So there are combinations in nature so constituted and arranged in their atomic structure as to arrest the vibrations which act as electro-magnetic manifestations of a higher order than those of light, and these give us the phenomena of physical life, and the physical basis of this compound is salt, ammonia, and water in the presence of hydrogen, easily obtainable from alcohol, which is made up largely of this gas." Dr. Littlefield goes much further, and carries his huge claims to the startling ex-

Bastian's experiments, but took precautions, which the latter had neglected, to prevent the ingress of life during the processes of sealing the vessels, and though he varied the experiment in many ways no germs of life manifested themselves, so that Tyndall felt impelled to thus testify: "I affirm that no shred of trustworthy evidence exists to prove that life in our day has ever appeared independent of antecedent life."

The moral of Tyndall's statement is obvious; the value of Dr. Littlefield's or any one else's experiments in the artificial generation of life lies absolutely and solely on excluding every trace of pre-existing life and thus preventing contamination which must otherwise surely follow during the progress of the tests. Carelessness in this respect has led biologists, even those who believe in the hypothesis of abiogenesis, to cry down every attempt made looking toward the artificial production of life. At various times Spencer, Huxley, Darwin, and Pasteur were firmly convinced that they had found the secret of life, but repeated experiments wherein antecedent life was more rigorously excluded than before proved their efforts futile.

Evidently error of a similar nature has crept into the tests of Dr. Littlefield, and this is not said without due consideration, for the present writer has performed the experiment as above written, not one but many times, and in every instance the result was not successful beyond the mere crystallization of the chlorides.

It is true that more recent reports state that the development took place under sealed glasses thoroughly sterilized before beginning and sealed from the air when placed on the shelf, but it is obvious that there was every chance for pre-existing life to slip in, and so what would otherwise have been regarded as a wonderful achievement in science has not been taken very seriously by men skilled in either chemistry or biology.

Beznau Hydraulic Station.

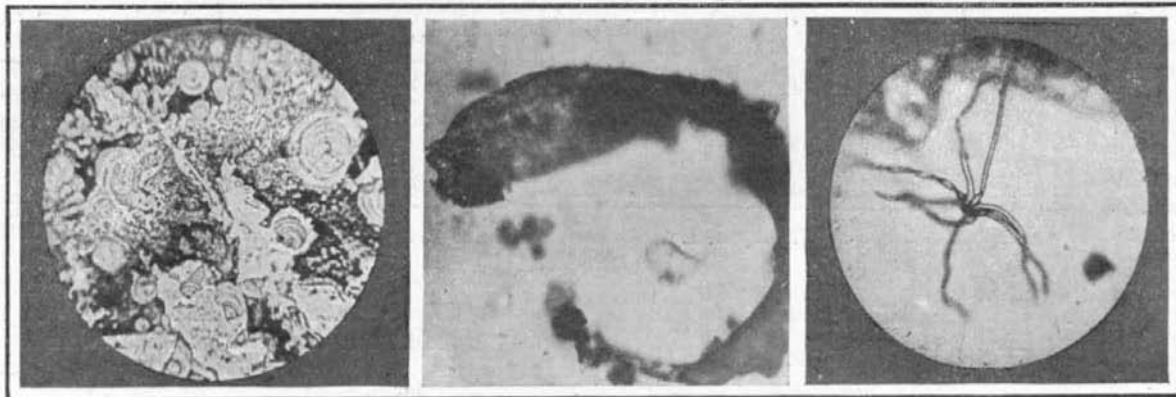
The hydraulic plant of Beznau, on the Aar River, situated about five miles above the point where that stream flows into the Rhine, is employed to distribute current throughout a very extensive region. It has three main transmission lines which run in different directions through the region. Lines at 25,000 volts run by various localities to Rheinfelden at a distance of 28 miles, to Entfelden (20 miles) and to Seebach (21 miles) and thence to Zurich, while near the station there are shorter lines which work at 8,000 volts.

When fully completed the central plant of Beznau will be provided with eleven alternating-current dynamos, mounted on the vertical turbine shafts. Each of these machines delivers 1,000 to 1,200 horse-power, and runs at 67 revolutions per minute. They produce a tension of 8,000 volts. Six of these dynamos are now in the station and three others are building. Current for the field coil is furnished by small 400-horse-power dynamos which give a tension of 200 volts. The machines thus deliver 8,000 volts to the lines directly and 25,000 volts to the other circuit by means of a set of transformers which raise the tension. Power is used throughout a very extensive region, for electric motors in factories, for lighting and tramways. The electric part of the Beznau plant has been installed by the Brown-Boveri firm, while the vertical-shaft turbines are built by Theodore Bell & Co. at the Lucerne works. At Rheinfelden there is a 3,000-horse-power sub-station which receives the high-tension current and lowers it to the voltage needed for use in the town, and helps out the hydraulic plant on the Rhine at that point.

Pistols for cavalry, first manufactured at Pistoja in Italy, were made in England, 1544; fire ships, 1585-8; balloons (by Mendoza) 1620; air-guns, 1646; bayonets at Bayonne, 1670; and throughout the period great improvements were effected in cannons and small arms, among others, the breech-loading gun and revolving pistol, specimens of which, made and used in the sixteenth century, can still be seen in the national museums of Europe.—Del Mar's "History of Monetary Systems."



Microphotograph of Supposed Flora. The Original Lifeless Material. Fern-like Forms.



SOME OF DR. LITTLEFIELD'S SUPPOSED CREATIONS OF ARTIFICIAL LIFE.

tent of affirming that he has produced a full-fledged insect which, though invisible to the naked eye, under the microscope became an entomological object the like of which has never been seen before. "It resembled an elongated house-fly" (to quote the doctor again) "having two antennæ protruding from its head, while from its body grew six attenuated legs, the two nearest its head being of the comparative form and length of a grasshopper, while its transparent wings were covered with light-colored hair. This new insect is the outcome of thousands of experiments, and it has no counterpart in the textbooks dealing with that branch of zoology."

It is a far cry from a simple protoplasmic cell to that of a highly organized insect such as that just described, in fact almost as far as it is from lifeless crystals to living matter. Oppositely, the higher critics will have none of it, basing their conclusions on practically the same grounds that Prof. Tyndall took in relation to Dr. C. Henry Bastian's experiments nearly thirty-five years ago. This scientist, it would seem, was eminently qualified to investigate the origin of life; for he was recognized as an authority on biology and the pathology of the nervous system, and he was a strong advocate of the doctrine of spontaneous generation of life. In one of his many papers he pointed out the results he had obtained in creating life artificially, and he declared that "observation and experiment unmistakably testified that living matter is constantly being formed *de novo* and in accordance with the same laws and tendencies which determine all the more simple chemical combinations." Prof. Tyndall took up the matter and carefully tested Dr.