Inorganic matter, like lime, or silex, always has this tendency to assume regular geometric forms, while organic protoplasmic or albuminous matter is never crystalline, nor regular in any form. It is called *colloid*. White of egg, and gum, or jelly, are instances of this colloid tendency. The smooth, soft, curved bodies of animals could not be formed with crystallized matter, which is also fixed in form, and unyielding. They require soft, formless, colloid matter. This explains why the soft animals are so variable, and those with hard shells, or frames, so regular in form.

There is a large class of these shell-covered unicellular beings, the *foraminifera*, that are very interesting in many ways. They belong to that indeterminate region of life midway between animals and vegetables, not being definitely established as either the one or the other. They are of various forms and sizes, though mostly minute, and they exist in countless numbers in various conditions, but especially at the lowest depths of the ocean, where their shells, minute as they are individually, form immense beds. Even at the depth of *three miles* the dredge brings up these foraminifera, dead or living, and often nothing else.

The deposit which results from their decay is almost identical with the *chalk* found so abundantly in England, and which contains similar remains. Apparently, at the present time, just such a formation is being made in various places at the bottom of the present ocean.

Among the various forms of the foraminifera, we find triangles, quadrangles, crescents, disks, objects like boats, and all kinds of beautiful *curves*. The little shields, or shells, often of pure *flint*, are sometimes most beautifully dotted, or regularly marked with arabesque lines, in various ways, but nearly always in regular patterns. They are sometimes called *brittleworts*, from their extreme fragility. They move about in the water by spasmodic jerks, with various degrees of rapidity, apparently from the impetus given to them by currents of fluid established between them and the surrounding medium, by osmose.

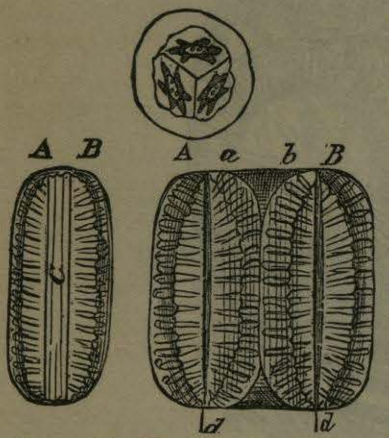

FIGURE 26.—*The Surirella—Diatom.*

In the smaller figure, *A* and *B* are two Diatoms, held together by a broad band, *C*. This band becomes gradually wider, as shown by the space *d*, *d* in the larger figure, and there is formed from it a new half for each of the original diatoms, and there are then *four* individuals—the two originals, *A* and *B*, and two new ones, *a* and *b*, thrust in between them. The next step is the division of the four into two pairs, by a separation down the middle, *A* and *a* going together, and *B* and *b*. Then each of these new pairs divides again, just as *A* and *B* did at first.

Although they are single-celled animals, the foraminifera are generally found in pairs, closely united, so that the two look like one individual divided by a line into two equal parts. This arises, however, from their peculiar mode of multiplication, each individual splitting in two, and each part becoming a perfect individual. Each of these new beings divides in two again, and so on indefinitely. Owing to this peculiarity of form they are called *Diatoms*, from a Greek word meaning *cut in two*. They are always seen in this process of dividing, so that each one always appears to be a pair. The accompanying figure shows this peculiarity very well: it represents a diatom called the *Surirella*.

The foraminifer is not completely surrounded by its shell, or case; there is always

some part, or parts, where it is open, and where osmose can take place, as it does in the whole surface of the amœba. In many cases, also, the shell is full of little holes, resembling dots, through which it can at any time push ready-formed limbs, or thread-like arms, like an amœba.

The following cut shows various forms of the foraminifera.

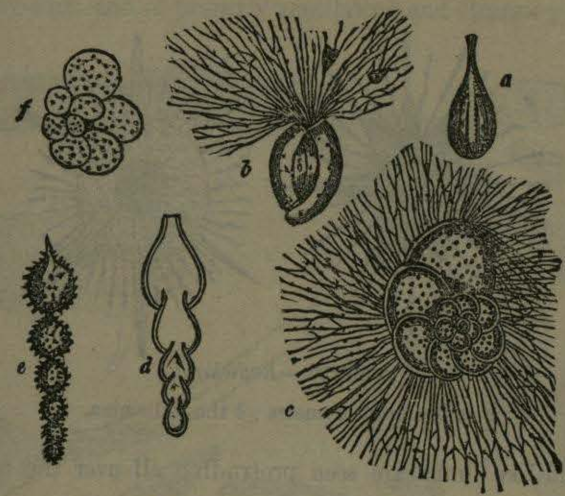

FIGURE 27.—*Various Forms of Foraminifera.*

a. A flask-formed Foraminifera. *b* shows the temporary limbs pushed out in large numbers, from the opening in the shell which serves as a mouth. *c*. Another form, showing the limbs protruding, like a bunch of hair, from the little holes of the shell. *d* and *e* are other forms. *f* is a peculiar foraminifera, called *Globigerina*, found in immense numbers in the sea, down to the lowest depths, being sometimes dredged up from three miles below the surface.

The oldest known fossil animal is one of the foraminifera. It is called the *Eozoon*, or *dawn* animal, and was discovered, quite recently, in Canada, in one of the most ancient known rocks, previously thought to be quite destitute of all animal remains.

There is one form of limestone, found in large beds, called *nummulitic* limestone, from the immense number of shells called *Nummulites* found in it. They are all shells of foraminifera that lived untold ages ago. The stone is in parts almost entirely formed of them. A few forms are shown below.


FIGURE 28.—*Nummulites, from the Eocene Strata.*

This is the stone used so largely in building the Pyramids of Egypt.

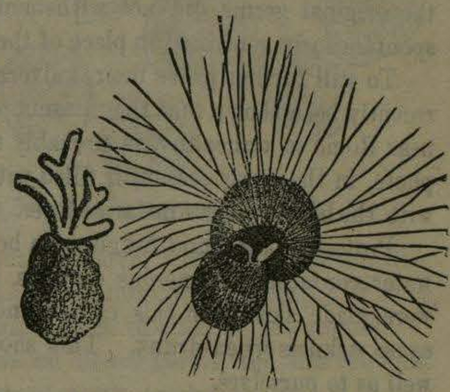
FIGURE 29.—*Miliola.* The Infusoria which mainly composes the limestone of which Paris is largely built.—Magnified.

Some other forms with hard skeletons, and numerous spines, are called Radiolaria. Two of these are figured below.

They are both single-celled animals, or protozoa, and the kind represented by *a* is called *acanthrometra,* or thorny. The large spines are formed of flint, and are hollow, forming tubes through which the thread-like limbs are thrust, as seen in the figure; but there are limbs that do not come out of the spines, as will be seen.

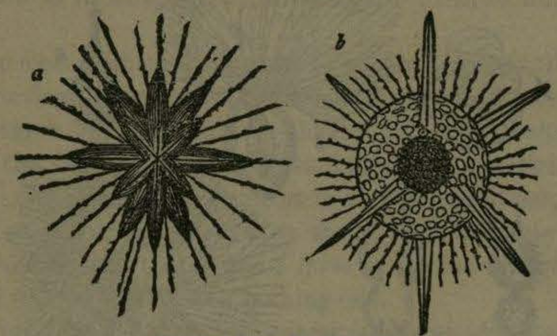

FIGURE 30.—*Radiolaria.*

a is the Acanthrometra; *b* the Haliomma.

In *b* the thread-like limbs are seen protruding all over the surface, as well as through the six large spines.

The variety of form, structure, size, and mode of living of these primitive organisms is simply indescribable. As we advance upward among them, we begin to find permanent limbs, true stomachs, proper mouths, and a circulatory apparatus. In other words, different parts of their structure become *differentiated,* or specialized, for particular uses. From these we ascend to others, still more specialized or perfected in their development, and formed of larger aggregations of cells, till we arrive, by successive gradations, through various types, up to the most perfect of all.

To show how difficult it is to destroy the germs of the lower organisms, it may be stated that Mr. J. Wyman found that some of them were able to withstand four hours' boiling; and Mr. Grace Calvert asserts they can endure either 400 degrees of heat, or 17 degrees below freezing!—an astonishing range, far beyond what higher organizations can pass through unhurt. But it is quite possible that the original germs did not withstand this treatment. New ones may have been spontaneously generated in place of them.

To still further prove their universality and importance as regards health, it has recently been shown that the miasma, or poisonous air, which makes the Campagna near Rome so unhealthy, is probably caused by a microscopic fungus. The atmosphere, in the sickly season, is filled with this minute organism, which being inhaled with the breath causes malarial fever.

Professor Low found funguses in both the milk and the blood of cows that drank water containing numerous diatoms, and other similar beings. Many of the cows were made sick from this cause; and it is quite probable that their milk might cause sickness when drunk. This shows the need for pure water to our animals as well as to ourselves.

In short, microscopical infusoria are everywhere, and have more to do with health and disease, and with changes in the world at large, than many people suspect.

The lower organisms, bacteria, vibriones, and funguses of various kinds, are

very generally found in many epidemic diseases. The horse disease, so prevalent a few years ago, illustrates this very well. The following cut shows the appearance of the discharge from the nostrils of a horse affected with the *epizootic influenza.*

Most of these are fungoid growths of various kinds. Their spores, or germs, were very numerous, some thousands being found in a single drop. They were also detected floating in the air, which shows the necessity of keeping diseased animals away from healthy ones, and of properly ventilating and cleansing their stables.

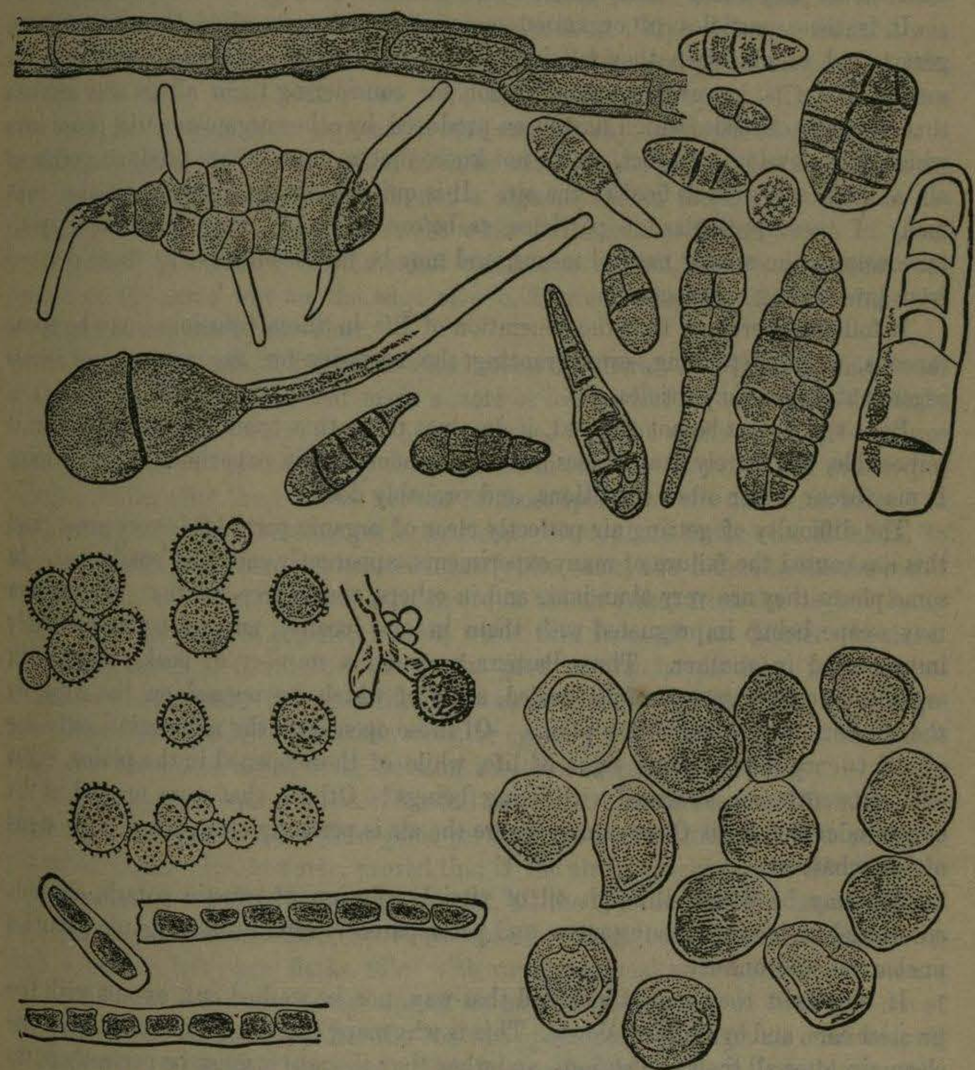

FIGURE 31.—*Mucus, from the Nostril of a Diseased Horse, much magnified.*

It is very probable that many kinds of chronic catarrh, especially what is called *hay fever,* may originate from similar growths, the mucous membranes of some people being favorable to their development, while those of other people are not.

In connection with this topic, the new views on disease germs, and also the most recent experiments of Professor Tyndall on spontaneous generation, should not be passed over without special mention. As far as the artificial generation of life is concerned, in infusions confined in sealed tubes, without air, or with air perfectly teen or thirty minutes, and others, again, almost every period up even to eight hours boiling. Possibly there are even some that will survive more than that, while there are others that will be killed if the water be no hotter than can be borne by the hand. The infusoria themselves do not endure these intense and prolonged boilings; it is only the dry, hard particles, which are so dense that probably the boiling water does not penetrate them, except with extreme difficulty. In proof of this, Tyndall shows that if any infusion full of infusoria and their germs, be only slightly boiled, at repeated intervals, so as to attack the living beings as they develop, one after another, the whole infusion will in time become quite sterile. He shows further, by another experiment, that an artificial mineral fluid, which infusoria will live and propagate in, if placed there, will not develop them, though it be plentifully supplied with atmospheric germs.

In a more recent communication, Dr. Bastian argues that Tyndall's experiments by no means justify the conclusion he comes to. He especially calls attention to the fact, that animal germs, or, indeed, animal tissue of any kind, cannot be compared with *seeds*, and plant tissues. The horny coating of many seeds may, as experiment proves, withstand very prolonged boiling; but animal germs are essentially composed of albuminous and fatty matters, which are entirely changed by a very moderate degree of heat. In fact, all known germs of the lower animal organisms are mere naked specks of protoplasm, none of which, as experiment has shown, can stand a heat of even 180° for a single minute. How, then, could they survive a much greater heat for a much longer time?

Dr. Bastian does not deny that the organic particles in the air may materially hasten the development of organisms, in an infusion, and, perhaps, even determine it, in some cases, when it would not otherwise take place; but he still contends that this development does often occur, in sealed and boiled infusions, without their aid; and Dr. Burdon Sanderson testifies that he has watched Bastian's experiments, and is certain of the truth of this. Other experimenters, also, have obtained similar results, so that Bastian's statements seem fully confirmed. There are, then, but two conclusions which can be arrived at in regard to this matter: either the organisms formed under such circumstances are spontaneously generated, or they, or their germs, can withstand *boiling* for an indefinite period, and yet live! Bastian contends that it is more consonant with known facts, and more reasonable, to suppose that spontaneous generation does occur, in such cases, than that the organisms we find have withstood such treatment; and many agree with him. The question, therefore, is by no means decided, and it is fortunate there are such excellent champions, on both sides, hard at work in support of their respective views; for it is only by continued experiments and observation that the truth can possibly be arrived at.

A few remarks from eminent men, bearing upon this question, may here be useful to note. Burdach very pithily reminds the germ theorists that they have never shown their germs; and that when they say, they are too small to be discovered, it is tantamount to saying they know nothing about them.

Mr. G. H. Lewes, in his "Physical Basis of Mind," says: "I cannot see the evidence which would warrant the belief that life originated solely in one microscropic lump of protoplasm, on one single point of the earth's surface. On the contrary, it is more probable that from innumerable and separate points of this teeming earth, myriads of protoplasts sprang into existence, wherever, and whenever the conditions of the formation of organized substance were present. It is probable that this has been incessantly going on, and that every day new protoplasts appear, struggle for existence, and serve as food for more highly organized rivals!"

Huxley says: "It is not probable that there is any real difference in the nature of the molecular forces which compel the carbonate of lime to assume and retain the crystalline form, and those which cause the albuminoid matter to move and grow, select and form, and maintain its particles in a state of incessant motion. The property of crystallizing is, to crystallizable matter, what the vital property is to albuminoid matter (protoplasm). The crystalline form corresponds to the organic form, and its internal structure to tissue structure. Crystalline force being a property of matter, vital force is but a property of matter."

All this fully accords with what has previously been stated, and shows that the idea of all matter being alive, in different degrees and ways, is very generally held, by those whose studies make them competent judges. Life is but a form of motion, and all matter is constantly in motion, no matter in what form or condition it may be.

The atoms composing a solid mass of rock, or iron, are not fixed and at rest, though they appear to be so; but, on the contrary, are perpetually changing their position in regard to each other. A bar of freshly hammered iron will appear uniformly fibrous, or lamellated, when examined, but after being left for a while will be found, on breaking, to have become perfectly *crystallized*. The atoms comprising it have rearranged themselves, according to the laws of their polarity, just as particles of salt in solution arrange themselves in crystals when the solution evaporates. Solidity is not motionless fixity, as commonly supposed, but merely a state in which change takes place slowly. Motionless or dead matter does not exist. Every atom is instinct with life, and organized bodies represent the combined vitality of all the atoms which compose them. As Huxley says: "Beast and fowl, reptile and fish, mollusk, worm, and polyp, are all composed of structural units of the same character, namely, masses of protoplasm, with a nucleus (cells). . . . What has been said of the animal world is no less true of plants. . . . Protoplasm, simple or nucleated, is the formal basis of all life. . . . Thus it becomes clear that all living powers are cognate, and all living forms are fundamentally of one character."

Further than this, it may be remarked, the protoplasm of which they are all made is merely part of the ordinary world material, such as helps to form thousands of other bodies, commonly thought to be dead, or inert, but which merely live in a different way.

In regard to special disease germs, some of the most eminent physicians and sanitarians, Dr. Richardson, of London, especially, have expressed their decided disbelief in them, and the reasons they give seem very cogent. It is true that in many diseases peculiar infusoria are found in abundance, in various parts of the body, and there seems no reason to doubt but that these organisms, when placed in contact with a healthy body will, at least in most cases, inoculate it with the same disease; but it by no means follows that such diseases are always caused by the germs of these infusoria, carried in the air. If it were so, few would escape, and our struggle against such diseases would be almost hopeless. It seems much more probable that the infusoria are effects of the disease more than causes of it, but that, when produced, they may extend it by being conveyed into healthy bodies.

The theory of *Panspermism*, or the universal diffusion of germs in the atmosphere, from which all the inferior organisms originate, has certainly many difficulties to contend with, and some of them seem insuperable. M. Trecul has demonstrated that in the very interior of the substance of several plants, especially the *caladium*, in the hermetically sealed cellular tissue, numerous rudimentary plants are to be found. Now, it seems scarcely possible that either these or their germs could have been conveyed there, and the more reasonable supposition is, that they arose spontaneously, either from perverted cell-growth, or as some necessary adjunct to the caladium itself.

There are plants, also, that only appear occasionally, at long intervals, under exceptional circumstances, and it seems scarcely possible that their germs should remain in the air, waiting, as it were, for these conditions to be established. Thus, there is a fungus which is found only on dead spiders, and another appears only on horses' hoofs when they are decaying. Certain moths also have peculiar parasites, found only on them, and there is a tropical caterpillar on whose neck grows a fungus of enormous size, proportionately, and which is found nowhere else.

Is it conceivable that these germs were in existence, floating in the atmosphere, waiting for dead spiders, decaying horse-hoofs, and certain caterpillars? Is it not more reasonable to suppose that they originate spontaneously, whenever these peculiar conditions are established.

Every form of fermentation is accompanied by the growth of a peculiar plant, which is never known to come into existence except when this kind of fermentation takes place; thus there is the yeast-plant, *torulæ*, found always in fermenting beer. Now, man must have existed many centuries before he discovered the art of making beer, and during all that time, according to the Panspermists, the germs of the torulæ must have been floating round in the air, waiting for the first brewing. Is it not more likely that the fermentation gave rise to the torulæ, without any previously existing germs?

But, stranger still, there is a plant called the *Racodium cellare*, which is never found except on the casks in our cellars, and the question naturally arises, Where were the germs previous to the first cask and the first cellar being made?

Bérard even tells us that there is a plant which is found only on the drops of tallow which fall from miners' candles. If these come from germs, they must have been floating round for thousands of years, waiting for the first miner to come with his dip! Is it not more likely that the first drop of tallow, in such circumstances, generated spontaneously the first of these singular plants?

It is also well known that every sick plant is immediately attacked by its peculiar parasite, which never appears elsewhere; and when we think of the thousands of different plants, it seems scarcely reasonable to suppose that there are as many thousands of peculiar germs waiting for some of them to become sick, so that they may grow upon them.

It would seem, in fact, that if all these thousands of peculiar growths come from germs, the atmosphere must be loaded with them to such an extent as to be quite unfit for breathing; but we know this is not the case. It must be remembered that if Panspermism be true, *every kind* of germ must exist *everywhere*—that which grows on the dead spider only, for instance; for, take the spider anywhere and kill him, and the peculiar plant is immediately found upon him.

Besides, as before remarked, the closest observation with the most powerful glasses fails to detect these germs, so that their existence is only hypothetical. They are inferred, not proved, to exist.

It is true the air is full of organic matter—in cities, at least,—but the nature of it is well known. The microscope shows us that the atmospheric dust which we see in the form of *motes* in the sunlight, is composed of fragments of animal bodies, of our clothes, our furniture, and of everything that we handle or use. Farina especially, or wheat-flour in small grains, is everywhere, being carried by the air. Pouchet says he found it in the dust of Egyptian tombs, where it had probably remained from the time of the Pharaohs. It is constantly falling upon us, and upon all other objects, so that no place is free from it. Insects, as they fly through the air, constantly receive grains of it on their wings, and it is always found in the falling snow.

The skeletons of infusoria also abound in the air, and even live infusoria of various kinds. Fragments of wool, cotton, silk, leather, smoke, remains of insects, and numerous other things are revealed by the microscope, but very rarely eggs or seeds of any kind, although according to the Panspermists, they ought to be the most abundant of all.

All the above-mentioned matters reach our lungs as we breathe, and may be found there after death; even living infusoria are sometimes so met with. The hollow bones of birds, to the interiors of which air gains access, are also occupied by them, sometimes one ingredient preponderating, and sometimes another, according to the conditions under which the animals live. Thus, Pouchet found in the bones of a peacock, which lived at a château, remains of the dresses of the ladies who promenaded on the same terrace with the bird. In a common fowl also, from a baker's, he found abundance of flour, and remains of the coarse woolen clothes of the baker and his family.

In like manner, birds from the fields, woods, or cities, will all show different kinds of remains in the air of their bones, so that from these remains we could judge what kind of life the animal had led, or where it had lived.

Now these organic fragments, as before explained, may probably assist in the primary production of simple organisms; or by their decomposition they may help to form protoplasm; but they are not true germs or seeds.

In short, we find peculiar living organisms under all circumstances, appearing instantly when the conditions are suitable, and varying with these conditions, but we do not always find the germs or seeds from which they originate. In fact, such seeds, or germs, are found but very rarely, and all this certainly favors the theory of spontaneous generation.

The large plate shows a peculiar moth, found in New Zealand, called the swift-moth (*Hepialus virescens*), with its caterpillar, on the head of which grows a peculiar fungus (*Cordiceps Robertii*). The fungus finally roots the caterpillar to the soil, as will be seen, and literally transforms the whole of the animal into the fungus.

Dr. Jos. Hooker describes, in the London *Journal of Botany*, an allied species called the *Sphæria Robertii*, of which a representation is here given. The caterpillar is seen buried in the ground, and the fungus growing above from it.

The following is Dr. Hooker's description:

Sphæria Robertii, N. Zealand: HOOKER.—"They are found in spring, generally under tree-ferns; the caterpillar is buried in the ground, as is the lower portion of the fungus. The entire body of the insect is filled with a pith, or corky vegetable substance, and the intestines are displaced. What does the muscular fiber of the animal become? It must, I suppose, be all turned into vegetable, for the skin of the creature remains quite sound all the time. . . . The whole insect seems entirely metamorphosed into vegetable, with the exception of the skin and intestines.

Mr. Taylor and Mr. Colenso hold the same opinion, that in the act of working the soil (to bury itself), the spores of the fungus are lodged in the first joint of the neck, and the caterpillar settles, head upward, to undergo its changes when the fungus develops itself. It is like the green mottled caterpillar, which produces a large brown moth, numbers of which skim all about.

The body of the insect was solid and pithy, the outer skin attached to the substance of the center, which has no roots in it, and, moreover, the pith is of the same substance as the stem, which is as thick, if not thicker, than the body of the caterpillar. Both the pith and the stem, when burned, have a strong animal smell."

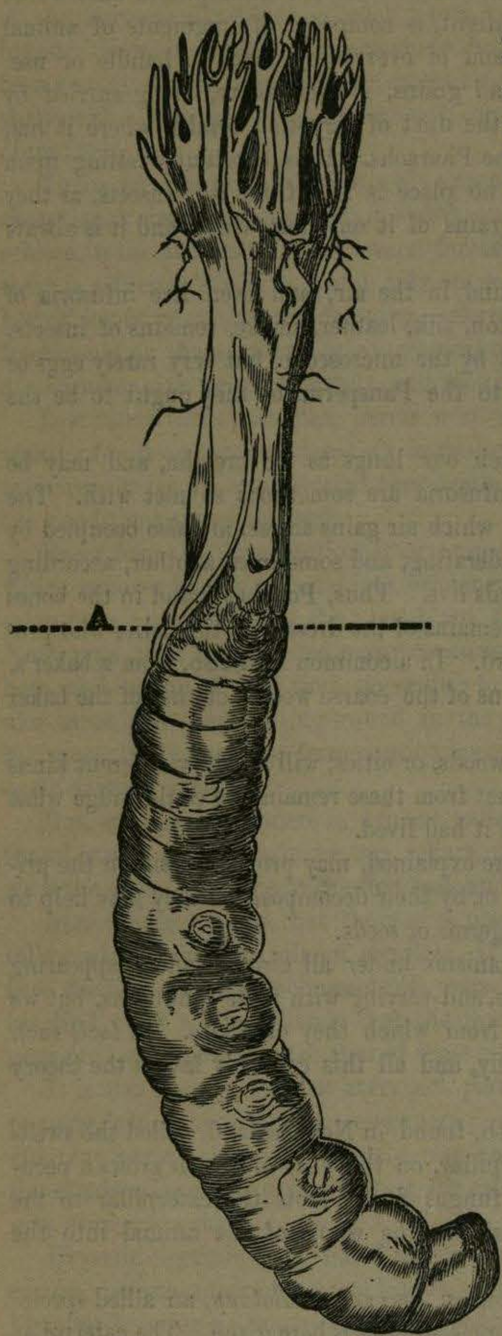

FIGURE 32.—*Sphæria Robertii, or Fungus Caterpillar.*

A is the level of the ground, the part below being the caterpillar, and the part above the fungus which has grown from it.

Reference should also be made, in this connection, to the interesting experiments of Mr. Crosse, Mr. Weekes, and others, in the production of insects in mineral solutions by means of a current of electricity.

Mr. Crosse was the first who observed this phenomenon, now many years ago. He was engaged in experiments upon chemical decomposition and crystallization, under the influence of electricity, without any thought as to the production of living beings. In fact, such a thing would have been thought impossible, from the nature of the materials operated upon. These consisted of powerful acids and other chemicals, used as solvents, with flints and similar hard mineral substances.

His idea was to submit his solutions to a long-continued slow action of the electric current, so that change might occur gradually, as it does in nature, and the results gained were extremely interesting and valuable. Many substances were thus formed, artificially, for the first time, and the manner in which others are naturally produced was clearly shown. One day, while inspecting a solution which had thus been a long time under electric influence, he was surprised to see around the negative pole of the battery several living insects, of the

PLATE III.

The Caterpillar Fungus.

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species called *Acarus!* They were of a peculiar kind, and seemed to be quite at home in the chemical solution where they were found; in fact, they lived only in that, as others live in water.

Subsequent experiment showed that insects always appeared, under the same circumstances, and not only in that solution, but in others—even in *poisonous* ones—under the influence of the electric current. The insects varied according to the materials used, and each kind, as a rule, could live only in the medium in which it was formed.

The announcement of this discovery caused the wildest excitement in scientific and theological circles, and Mr. Crosse was subjected to so much abuse for his discovery that he almost regretted having made it. He was denounced as materialist, atheist, and everything that was dreadful; but nevertheless the *Acarus Crossii* was there, and had to be recognized.

Attempts were then made to show that it was merely a case of generation from *atmospheric germs,* and not spontaneous. But still there remained the questions,—Why do particular kinds of insects appear only in certain solutions, mineral and poisonous?—and Why is the electric current always needed? To these questions no satisfactory answer has been given, and many very competent judges are still of opinion that these *Acari* are spontaneously generated by the influence of electricity. Such experiments have been repeated, since Crosse's time, by many persons, and always with similar interesting results. Among others, Mr. W. H. Weekes has perhaps been the most successful.

In a communication made by him to the author of the "Vestiges of the Natural History of Creation," he gives full details of some very carefully conducted experiments, made specially as tests. He took a glass vessel, so made that no air could gain access to the interior, except as he wished, and this was connected by inserted wires with a constant galvanic battery. Into this vessel he conveyed a solution of *prussiate of potash* (a very poisonous salt), and also a quantity of *oxygen gas,* so that the vessel was filled in the lower part with the solution, and in the upper part by the gas, there being no common air admitted, and consequently no *germs* could possibly find their way there. Every precaution was taken, both by boiling the poisonous solution and by sending the gas into it straight from the white-hot retort in which it was generated. There was, therefore, only the gas and the solution in a perfectly air-tight vessel.

Then some of the same solution was put in a vessel open to the air, and the electric current was made to pass incessantly through both—entering the open vessel first.

Various chemical changes took place, but no insects were seen till one hundred and sixty-six days after the electric current began to flow. Then, *in the open vessel,* the first ones were seen, and they continued to be produced in quantities for several months. During this time nothing of the kind took place in the closed vessel, but after *two years* the solution therein seemed to change very much, *and the insects appeared in it also,* just the same as in the open vessel! This would seem to be conclusive, for if it be granted that the open vessel might have received germs from the air, certainly none such could have reached the interior of the closed one, with its oxygen atmosphere.

Mr. Weekes also describes another experiment, in which a thin solution of refined sugar was submitted to continuous electric action. The result was the production of a peculiar *fungus* different from any previously known, and which only came under the electric influence. Both this and the insects, it is worthy of remark, always first appeared in connection with the negative pole of the battery.

Now, the whole earth, with its beds of metallic minerals, and other chemical substances, is a vast *galvanic battery*, through which electric currents are constantly passing, causing chemical changes on a stupendous scale, and, probably, also engendering life, as they do in the experiments above described. It would be strange indeed if it were not so, for natural forces act uniformly and unerringly, on the small scale and the large alike.

In the earlier ages of the world also, as before remarked, the general conditions were more favorable for organic development, and the electric force more intense, so that living beings were much more readily and abundantly originated.

Experiments of this kind are now being persistently conducted, by men who have no fear as to what may be discovered; and I feel a firm conviction that we are on the eve of discoveries which will revolutionize the whole science of Biology,—so far as the first *origin of life* is concerned.

Observations have shown that bacteria, and other such forms of life, often appear in different internal parts of the body, apparently as a result of deranged nutrition, or circulation, in that part. It would seem that if any such internal part be cut off, as it were, from the general organic life, or isolated, a morbid condition sets in which entirely changes its mode of cell development. In such circumstances infusoria of various kinds are produced, and probably intensify the diseased condition. They may also, as before observed, propagate the disease in any healthy body to which they may gain access. They are therefore, properly speaking, the products of disease, though quite capable of extending it.

Dr. Richardson is decidedly of opinion that the so-called contagious diseases result from diseased secretion, caused by glandular derangement; but that the contagion, whatever it may be, which they give off, may also be an active cause of the disease in those who encounter it, providing they are in a condition to be affected. This is a very different doctrine to that held formerly—that these diseases always began from germs disseminated from one body to another—and it is not only more likely to be the true theory, but it is also much more encouraging to us in our contest with disease.

As a further confirmation of this view, another fact may be noticed, which apparently proves the theory of spontaneous generation. On carefully dissecting a body some time after death, bacteria will often be found, in abundance, in the fluids of various internal parts, where it is certain they could not have been while that body was living; and where observation, immediately after death, had shown conclusively that there was nothing of the kind. The condition of the parts is such, being closed cavities, that it is certain germs could not reach them from the air; and as they could not always have been there, the inference seems warranted that they were spontaneously generated when death occurred. These parts, being no longer working portions of the whole body, are thrown, as it were, on their own resources; the fluids in them decompose, fresh cellular development sets in, and infusorial life results. This seems very probable, and I see no other way in which the existence of these living organisms, in such circumstances, can be accounted for.

In all probability every animal body, immediately after death, is filled with various forms of infusoria, thus spontaneously generated, and they very likely assist materially in its decomposition.

In what is called Splenic Fever there is developed a peculiar animalcule, called the *Bacillius anthracis*, which undoubtedly is a main agent in aggravating and extending the disease. It is in no way whatever distinguishable from the common *Bacillius subtilis*, which is quite harmless.

Now a man may be attacked with Splenic Fever, in any part of the world, where it had never been known before, and this animalcule would immediately show itself. Whence, then, does it come, if it be not spontaneously developed in the diseased secretion? It is true this organism may cause the same disease in another person, if he be in an apt condition; but it seems certain that both disease and bacillius will arise spontaneously, where neither was known before. This certainly supports the view, that the disease may originate the bacillius, in the first instance, though this may extend the disease afterward.

The important part which the lowest organisms, or unicells, play in the general economy of nature is every day being made more and more apparent. In fact, pretty much all organic change is effected by their agency. One of our latest and most eminent physiologists—Foster—asserts, in regard to the human being, that the total action of the whole body, of every kind, is nothing but the aggregated action of countless amœba-like organisms of which it is composed.

It was long a mystery in regard to the natural nitrate salts, such as saltpeter, whence came the nitric acid they contain? The oxygen and nitrogen which form this acid, of course, exist in the air; but by what agency are they brought together and united chemically? Many theories have been advanced to explain this, but none of them have been satisfactory. Latterly, however, it has been shown that nitrogen is oxidized by the action of certain simple-celled organisms, which, during their rapid growth and extension, effect the combination of the two elements. They operate in the same way as the yeast-plant—*torulæ*—which by its rapid growth causes alcoholic fermentation; or like the vinegar plant—the *Mycodermi aceti*—which during its growth causes the elements of acetic acid to unite, and form vinegar.

This discovery connects nitric acid with the organic world equally with acetic acid, and shows that the old distinction between organic and inorganic chemistry is unfounded. It is a further proof that all natural processes are essentially the same, and that there is no absolute break between organic and inorganic life, but that one passes insensibly into the other.