

a sort of middle ground. If, on the one hand, the telescope enables us to look beyond this earth to find that vast unknown studded with system after system, ever multiplying as we farther reach, till we find them occupying all visible space: so, on the other hand, the microscope brings us into more intimate relations with things immediately about us, opens our eyes to beauties before undreamed and gives us a knowledge of the infinity of little things, truly surprising.

The examination of any organic tissue, whether animal or vegetable, or even almost any inorganic substance, when we bring to our aid the modern microscope, reveals such a world of beauty and furnishes so much material for wonder and admiration, that the novice is extremely puzzled for awhile, to know what to observe and what to pass by unnoticed.

After procuring my instrument, like all tyros in microscopy, I must have my turn at diatomizing: that is, studying those minute and exceedingly beautiful forms, everywhere abundant, called diatoms, a class of objects exceedingly unfortunate in their structure, in that they exist so near the confines of the two great kingdoms of organic bodies that they have scarcely been given an abiding place,—being now called animal and now vegetable,—now cuffed about in this kingdom and now sent to that: though, suffice it to say, that after this repeated tossing from one kingdom to the other, they are now, together with their cousins, the desmids, almost universally admitted into the domain of the Botanist and can really have nothing to claim the attention of the student of exclusively animal structures.

I will first mention these because they were my first acquaintances. I received from a friend one of those little miniature bottles which a certain school of physicians fill with miniature sugar pills, touched with miniature medication to be dealt out in miniature doses. But instead of the conscience-easing medicine, it was about half-filled with a clear liquid and labelled, "Department of the Navy,—Diatoms from Charleston Bar,"—a half-teaspoonful of apparently clear liquid furnished by this powerful nation! I thought it little worth but proceeded to examine my prize. I took a single drop, and almost doubtfully focussed upon it with a moderately magnifying power, looking at not more than a hundredth part of the single drop and what was to be seen? Wonder of wonders, enchanted ground,—a curiosity shop,—a jeweler's show-case, pleading for admiration! Here a disc-shaped object, not unlike the back of a plain watch-case with its peculiar markings, produced by concentric rings just overlapping each other: and right near to this, another object closely resembling an elegantly chased bracelet laid in squares ornamented with beautiful carvings; and just to the left, another object resembling a beaded ring set with garnets, also a necklace to beautiful design. But I must not stop to enumerate. As I moved the successive parts of the drop under the glass, new objects would be brought out: in short, there were in that single drop objects sufficient for hours of study, yes, *days* of downright study. This was from "Charleston Bar." I afterwards examined others from Georgia, from Richmond, Va., from Cuba, and from other places, and in each there were new forms not found in the others, some of which were beautiful in the extreme. These however you will have noticed were all from the sea shore. But books informed me that similar forms might be found in the sediments of fresh water, in the mud at the bottom of permanent ponds. This I tested and found to be true. While the outlines and some of the peculiar markings were different, yet many of the general characteristics showed their unmistakable relationship.

Now the question arises, what are these objects? The earth from which they are taken is termed "infusorial earth," and the forms of objects themselves are termed "fossil infusoria." They are found in all parts of the world and play an important part in most of the recent geological formations. So exceedingly minute are they that this seems impossible yet it is nevertheless true. What they lack in size they more than make up in numbers. The City of Richmond, Va., rests upon a bed of this "infusorial earth" twenty feet in thickness, one cubic inch of which has been shown to contain many millions of these forms. This would furnish us with an absolutely inconceivable number. But all along the Pacific coast are found beds far surpassing this in extent. One along the Columbia river in Oregon, discovered by

Gen. Fremont, surpasses all other known deposits, extending over the country for miles and being not less than *five hundred feet in thickness*. The so-called Tripoli stone, a scouring stone of California, is largely made up of these bodies, in fact all the substances in general use for the finer polishing purposes contain these "fossils" in abundance and from them derive their polishing properties.

But what are they? Let us see if we can determine. If I take a small bit of animal or vegetable substance and treat it with acids and alkalis I can cause the organic matter to disappear as such; but if I take bits of quartz or grains of sand which are all composed of Silica, the same treatment will produce no change. Now if I boil this infusorial earth in acid and then carefully wash the product, I have remaining these beautiful forms, and they are silica or quartz, the same in substance as the rock crystal or California diamonds, and all beautifully carved by God's own hand. If I take a piece of the scouring rush or a portion of the leaf of the sword grass and subject it to the same process I find remaining a complicated net-work of this same rock material. This quartz then, does find its way into vegetable substance.

You may have noticed upon the pools of standing water along the streets in early autumn, a dull brown scum, not unlike in color the scar leaf nipped by the early frosts. The microscope shows this to be made up of myriads upon myriads of minute forms moving about freely, but which the spectroscope has demonstrated to be made up of vegetable substance so far as the coloring matter and softer parts are concerned. Now if you take a little of this scum and subject it to the same process as was pursued with the infusorial earth you will be not a little surprised to find it made up of forms closely resembling those before mentioned. This scum then, lives and dies, and in dying helps to form "infusorial earth," and the process has continued so long that we now have the immense beds or deposits on the Atlantic and Pacific coast, to say nothing of their being constituents of various rock formations.

Can we not now begin to understand that there is an infinity of creation of things terrestrial as of objects celestial? and remember that these constitute only one class of infusoria and comparatively simple in their organization. There are scores of others, animal as well as vegetable, more complex in their structure and if possible more beautiful in their forms, to the understanding of which such men as Ehrenberg, Ralfs, and others have devoted a life-time of study. In all earths and in nearly all rocks may be found traces of these organisms. Surely the poet was not very far from the truth when he said:

"The dust we walk upon was once alive."

These little organisms have been so carefully observed that they have been arranged into groups and families as accurately as have the higher orders of animals. The known species now number several hundreds; and one of the most wonderful feats of microscopical science is the placing of these in groups of a hundred each on a glass slide for the purpose of study, arranged side by side according to their relationships and the whole row of a hundred with *ample spaces* between them occupying a space less than three-sixteenths of an inch in length.

Each improvement in the telescope reveals to us new worlds and new systems with every prospect of still others beyond. So each improvement in the microscope reveals objects unseen before and still the end is not yet. A moment's reflection is sufficient to convince any one that plants alone convert mineral matter into organized substance. No animal can derive sustenance from unorganized matter. Indeed the grand physical utility of the vegetable kingdom in the wonderful economy of nature seems to be the conversion of purely mineral substance into organized matter so that it may become food for animals.

If you will take a single drop of water in midsummer, from a pool in an exposed position, and place it under a high magnifying power, while to the naked eye it may appear perfectly clear and pure, yet under the glass it will seem to be a grand *colossal* garden—or rather, as the Psalmist would say, "a great and wide sea, wherein are things creeping, innumerable, both small and great beasts." In this miniature sea as in the great deep, we find animals that feed upon vegetable substance alone, and those also that feed upon other animals: and if you will watch their movements for a short time, you will see an even greater activity