

The works of Lyell put an end to the doctrine of catastrophism, but other researches have seemed to show that though the solar system might remain, life on this earth must have an end.

As is well known, both animals and plants need certain of the chemical elements as food, in order to maintain life, these necessary elements being carbon, oxygen, hydrogen and nitrogen, besides others of less importance.

Plants can use these elements for food when presented in the form of very simple compounds or even uncombined in the cases of certain of them. Nitrogen, however, must always be combined, to serve as a food, the plant being totally unable to use any of the vast quantity of this gas which forms four-fifths of the atmosphere, it there being uncombined.

With animals the food must contain the same elements, but combined to form very complex substances and as these are produced almost exclusively by plants in their growth, animals are directly dependent upon plants for life.

Turning to the sources of plant food we find in the soil and air an abundant supply of all the elements needed except nitrogen. The element, it is true, is abundant, but the supply of its compounds which the plant requires, is comparatively limited; those present in all soils forming the greater portion, the nitrate and guano beds being far from inexhaustible, and the other sources being few.

Here animals come to the aid of plants, for among the waste matters produced by animals are simple nitrogenous compounds which plants can easily utilize. In this we find a sort of circle of changes, the simple substances and elements being built up by plants into complex substances which are used as food animals which in return supply the plants with waste matters which are built up again.

This circle of animal and vegetable life might ever continue, each supplying food to the other, were it not for one great difficulty—the waste matter produced by animal life *is not all returned to*

the plants. Particularly is this true in our cities where the sewage is conveyed far beyond the reach of plants—to the sea.

With reference to the other elements this would matter little, the soil and atmosphere holding an abundant supply, but with the nitrogenous compounds the case is different—with only a portion of these returned, and with but a limited supply in the soil, the time must come when nitrogen starvation will result in the destruction of all plants, and in consequence, the total annihilation of life on this earth.

This has been the end expected. But recently science which discovered the interdependence of animal and vegetable life has discovered an influence struggling to restore the balance. It has long been known that land planted with clover, peas, beans or other leguminous plants, appeared to lose none of the nitrogen present in the soil. The reason for this is now known. In the little swellings so common on the roots of these plants, swarms of bacteria are actively at work, in some unexplained way taking the nitrogen from the air and so making it over that it can be utilized by the plants which in this manner receive the element previously lacking.

Bacteria are wonderful agents for good and for evil. They cause disease, but often supply the remedy; feeding in marshes and stagnant pools they render those regions inhabitable when otherwise they would be uninhabitable wastes; they aid in the preparation of our food; in cooking and in digesting it; butter, cheese and many other products require their presence to be successfully produced; and by this study of animal and vegetable food we see that even the presence of life on this earth may directly depend on the abundance and vigor of the bacteria of nitrification.

The grounds and buildings of the colleges in the United States are valued at \$56,119,826, their productive funds at \$60,597,142 and their total income, including state aid, \$8,293,444.