

And it is a well-known fact that there is evidence to show that there is considerable difference in the chemical properties of living and dead protoplasm. For instance, carmine and other coloring matters do not color living protoplasm, while on the other hand they give a brilliant stain to dead protoplasm.

To illustrate: Analytical chemistry is the pulling down of substances; synthetical chemistry is the building up of a more or less complicated product from its elementary constituents. For instance, if we heat a little sugar to redness in a test tube it leaves a black deposit, which is carbon, while a liquid, which is water, distils over; and on electrolyzing this fluid we resolve it into hydrogen and oxygen, so that we can thus show that sugar is composed of carbon, hydrogen and oxygen. This pulling down or taking to pieces of sugar (analysis) is an easy matter, but the putting these same elements or pieces together again (the synthesis of sugar) is a very different matter and much more difficult. You may put together carbon, hydrogen and oxygen in due proportions, and shake them all together, or heat them or cool them, and yet you will never get them to combine again so as to make sugar.

The analysis of dead protoplasm, animal or vegetable, is an easy matter, and consists of carbonic acid, water and ammonia. But no chemist has ever succeeded by synthesis, and probably never will succeed in putting these three simple ingredients together again, and thus making protoplasm. Chemical investigation can tell us little or nothing, directly, of the composition of living matter, inasmuch as all such matter must needs die in the analysis. Out of these three simple forms of matter, carbonic acid, water and ammonia, the vegetable world builds up all the protoplasm which keeps the animal world agoing. Withdraw any of these simple elements from the world, and all vital phenomena comes to an end. They are related to the protoplasm of plant life as the protoplasm of the plant is to that of the animal. It will thus be seen that plants are the accumulators of the power which animals distribute and disperse. We must bear in mind that no animal can make protoplasm, but must take it ready-made from some other animal or plant, the animal's highest feat of constructive chemistry being to convert dead protoplasm into that living matter of life which is appropriate to itself. Therefore, in seeking for the origin of protoplasm we have to turn to the vegetable world. The animal can only raise the complex substance of dead protoplasm to the higher power, as one may say of living protoplasm, while the plant can raise the less complex substance, carbonic acid, water and ammonia, to the same stage of *living* protoplasm. The fluid containing carbonic acid, water and ammonia, which offers such a Barmecide feast to the animal, is simply a table richly spread to the multitudes of plants, and, with a due supply of only such materials, many a plant will not only maintain itself in vigor, but grow and