

the body would not be renewed and life would end. Food must contain not only the elements of blood and bone, but of all the tissues of the body; and as all food, is either directly or indirectly supplied by plants, the plants must contain them. These substances then are the necessary constituents of plants. It is out of place here to speak of the manner in which the elements of vegetable structure are converted into the different substances which enter into the composition of animal bodies, and I shall say nothing on that subject.

The necessary constituents of soils are determined by a knowledge of what plants require. The food of plants is derived from the air which surrounds them, and from the soil in which they grow. We shall not in this place say of the atmosphere any more than that if the soil cannot obtain the proper food from it, then that food must be supplied artificially, or sterility will be the inevitable consequence. A certain portion of the elements of plants cannot from their nature exist in the atmosphere; they must then be present in the soil or vegetation cannot be produced, because without them plants cannot be formed. We can in this manner perfectly ascertain what substances are necessary to the plants that are used for food, from our knowledge of the matter in a human body which is furnished by that food, and also perfectly ascertain what are the necessary constituents of soils from a knowledge of the materials which these plants require for their complete development. The best proportions necessary to constitute a fertile soil can only be determined by the chemical analysis of a large number of fertile soils. With each examination one certain step is gained in the solution of this great question.

As examinations become more numerous the *minimum* quantity, that will produce the largest yield will be ascertained, and then the perfection of Agriculture will be attained. Of the substances to be described hereafter *all must be present to constitute a fertile soil* and they not only be *present*, but they must be in *sufficient quantities*, and in a form to supply the wants of the crop. What the *best quantity* is has not yet been exactly ascertained. We must not reject the aid of science, because it cannot at once give us a perfect system, we must compare what it affords with what exists without its aid. The one system is possessed of a degree of certainty continually approaching to perfection, the other is altogether empirical, and never takes one certain forward step.

I have said that all of the necessary substances must be present, and I moreover add that *an excess of any one* cannot compensate for the absence or deficiency of another. So that we have this general rule, that the fertility of a soil depends not on the *quantity* of several of the necessary constituents, but *upon the proper proportion of them all*.

To show this, I submit the following table, the facts of which are taken from numerous analyses made in England and Germany, by men whose reputation vouch for their truth, and from some made by myself in this State.