the composition of the air contained in the soil, to the absorptive properties of arable land, to an estimation of what amount, separately of ammonia and nitric acid is to be found in water, rain, snow, dew, and mist. The immense importance of such inquiries upon the future of agriculture, as tending to correct the present imperfect theories of manuring, must be apparent to any one whose mind is alive to the present state of the question.

It is usual to insist upon the presence of ammonia as food for the growing crop; but little is known as to the circumstances under which it is presented most advantageously.

If it be allowed—and this will not now be disputed—that plants grow only by addition of cells, and that these cells, consisting of two parts, owe their outer part or protection to the union of carbon and water, or its elements, and their inner part to ammonia, or its elements, nitrogen and hydrogen, it is obviously important to discover the manure in which nature works to supply this highly vitalized internal membrane, that we may learn how best to assist her. Although the elements of Ammonia are plentiful in the air, hydrogen by the decomposition of water to unite with nitrogen, M. Boussingault's experiments have brought him to the conclusion that the cell is not supplied with it dirictly from the atmosphere. Ammonia must be accounted for from elsewhere. In the course of his researches he says, that he found the seed to be a perfect storehouse of nitrogen and phosphorus, and of all the characteristic materials of the vegetable species whose seed it is. In virtue of the existence in it the seed grew in a chemically pure air and barren soil, and although fed only with pure water, developed into a perfect plant, which flowered and ripened seeds with no more nitrogen than was in the seed to begin with. It is well to remember that there is usually from five to six per cent. of nitrogen in the seed, while in the entire plant there is one per cent.

The experiments he made upon fertile soils abound with practical suggestions. As with the atmosphere so with the soil: although four-fifths of its bulk is nitrogen, plants can appropriate nothing from the atmosphere save a few stray particles of ammonia floating in it. In a fertile soil, similarly, there may be 96–100ths of nitrogen, "locked up from the plant in organic compounds, which the plant cannot decompose." Boussingault very justly says, on this evidence, that analyses of soils and manures, detailing the quantity of this constituent or of that, afford information really of little value to the farmer, who must seek to know the *conditions* in which they are found there, whether free or in bondage. He comes to the conclusion that the only sources of nitrogen, and those from whence the vegetable cell is composed, are ammonical salts and nirates Phosphates, he insists are indispensible in every case, and nitrogenous matter is also needful as a companion to the nitrate. "A nitrate is preferable to ammoniacal salt, inasmuch as nitrogen appea to be fully assimilable by plants, and being mo fixed is less likely to be lost than ammonia salts, all of which are more or less volatile."

We are scarcely aware how much depen upon carbon, and how important it is for a su ficient quantity to remain free to combine wi and fix the ammoniacal salts and nitrates in th tissues of the growing plants. Unless it is a liberty to perform this good office, such elements as these may exist to repletion in the soil without benefit to the plant. Carbon, however, serves a more important purpose still. As food plants, to whose existence it is essential, it can only become assimilated and combined with oxygen, that is as carbonic acid. Boussingault then details some interesting experiments suggested by this fact, to find the quantity of carbonic acid which exists in the air of the soil. One set of experiments he devised to prove the *quantity* of air held by soils of various kinds; another to ascertain the *quality* of that air. His evidence and substance with regard to the first set is as follows: The average for fair soils may be stated at 400 cubic yards per acre, taken at a depth of 14 inches; the entire volume of the acre taken to this depth is equal to 1,750 cubic yards; so that in such a soil the contained air is about a quarter of the density which it is in the superincumbent atmosphere. Soils very rich in humus and recently manured gave the largest quantity of unfixed air, sands and clays the least. With respect to quality, the experimenter found more carbonic acid in the air of the soil than in the atmosphere. In the latter it is usual to allow 4 parts carbonic acid in 10,000 atmospheric air; but a soil rich in humus contained 974 in 10,000, the soil of a meadow contained 179, and no soil, according to his experience, run short of 100 parts. Striking an average, the air contained in one acre of arable land, 14 inches deep, equaled 1,750 cubic yards; soil manured a year previously contained as much carbonic acid as is found in 9,446 cubic yards of the atmosphere; so that the acre of soil lately manured contains as much as there may be estimated in 60 acres of the atmosphere 14 inches deep.

Before referring to the conclusion deduced from such premises, there yet remains one point of special interest elucidated by these investigations. In comparing the oxygen of the air confined in the soil with that in the atmosphere, it was found that the latter is always deficient in this busy-body constituent by nearly the same quantity as goes to combine with carbon to produce carbonic acid. It is also not irrational to suppose that oxygen, beyond burning the carbon of the organic remains in the soil, unites also with the free hydrogen to be found there, and thus ministers to the wants of the rootlets in the matter of water as well as of carbonic acid. This service is more important than at first it appears