upon its obtaining all these, as well as one or two less important substances, in sufficient quantity; without these it cannot flourish, and just in proportion to the amount in which they are supplied will be the luxuriance of its growth. I say the growth of the plant will be proportional to the supply of these constituents. This statement, however, is not to be taken in its widest sense, because nature has fixed a certain *limit*, beyond which no supply of these substances, however liberal, will raise its growth but up to that limit the statement is substantially correct. From whence then is the plant to derive these substances? And in answering this question it is necessary to distinguish between the two classes of substances to which I have already referred and inquire separately into the sources of each. Of the inorganic constituents there can be but one source, the soil, namely, which to be fertile must contain the whole of these substances in greater or less quantity. It is different, however with the organic constituents which have a two-fold source, and of which part, or even the whole, maybe derived from the surrounding atmosphere. The atmosphere is, in fact a great reservoir of the organic constituents of plants of which it contains all four; two of these nitrogen and oxygen forming almost the whole of it; the other two, carbon and hydrogen, existing in smaller proportion in the forms respectively, of carbonic acid and the vapour of water. It must be understood, however, that all soils contain a certain quantity of the same substances, in form of what is called *organic matter*, in a state in which all these four substances may be supplied to the plant. Now, every *fertile* soil contains *all* the constituents of the plants which grow upon it, and that too in sufficient quantity to supply many successive crops, a position which I have had recently an opportunity of illustrating in a very complete manner in a series of analyses of the wheat soils in Scotland, published in the last number of the *Highland Society's Transactions*. I have there shown that even nitrogen, of all others, the element which we should least expect to find in them in abundance, nevertheless exists in what must be considered a comparatively large proportion. But it is important to observe that it is not enough that these substances shall exist in the soil; it is further necessary that they can become available to the growth of the plant. Now, to provide for this, nature has introduced an extremely beautiful and important provision In order that these substances shall be absorbed by the plant, they must exist in a soluble condition. It is, however, very manifest that if the whole valuable constituents were soluble, the good effects of such an arrangement would be altogether defeated; for the rains would soon wash away from our soils all that they contain of valuable matter. To obviate this, however, nature has so arranged it, that these constituents exist in the soil in the state of insoluble compounds, which, under the influence of air and moisture, gradually undergo a series of very complex decompositions, which slowly liberate the constituents, as they are required to support the life of the plant. But nature has fixed a limit to this change, and has caused these constituents to become soluble with extreme slowness, only, and in no greater quantity, than is requisite for supporting that amount of vegetation which the general economy of the globe requires. Now the whole principle of cultivation is to obtain, by proper treatment, from a given surface of land, a greater amount of vegetation than it is capable of producing in a state of nature. And this is effected partly by tillage, which breaks up the land, and by the admission of air and moisture facilitates the decompositions, by which these valuable constituents of the soil are liberated from their insoluble state. The other and equally important means is by the addition to the soil of those substances which the plant requires, in other words by the use of manures. A manure, then, ought to contain *all* the substances which a plant requires for its growth. And this is unquestionably what a manure of theoretical composition should do. Nay, more, it ought to contain these substances exactly in the proportion which the plant requires, so that no waste may occur. It must, however, be manifest to every one acquainted with agriculture, and still more manifest to every one acquainted with chemistry, that it is impossible to carry out practically what is true in theory: nevertheless, the aim of skilful and scientific practice ought to be to approach as near to theoretical perfection as it is possible to do, though in the very nature of things, we cannot even hope absolutely to arrive at it, or even near it. Although, however, we cannot hope to arrive at perfection, we may advantageously aim at a somewhat lower and less difficult standard, for experience and science concur in showing that all the constituents of a manure are not equally important, but that those are more essential which the plant has greater difficulty in obtaining from other sources. Now, in this point of view, nitrogen is the most important of all the constituents of a manure, because it is that which nature supplies least abundantly. You may possibly express some surprise at this statement, considering that I, not many minutes since, mentioned that it is at present in enormous quantity in the atmosphere. But it so happens that nitrogen is exactly of all others the substance which most peculiarly requires to be presented to the plant in a special condition. It has been established on most unequivocal evidence that the plant cannot absorb nitrogen *as such*, and that all this immense mass of nitrogen existing in the air is not directly useful to the plant, while it is only a very minute quantity existing in it, in the state of ammonia, which is of im-